Mineral Resources Division Report of Activities 1981

Nova Scotia
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and Energy

PROVINCE OF NOVA SCOTIA

DEPARTMENT OF MINES AND ENERGY

REPORT 82-1

MINERAL RESOURCES DIVISION REPORT OF ACTIVITIES

1981

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FOREWORD

As in the past, this Report is designed to provide a combination of general information on activities of the Energy and Resource Geology Sections and more detailed outlines of geological research being conducted by the Project Geology Section. Indices of Assessment and Open File Reports, Publications and Maps are appended for the use of the mineral industry, other research organizations and the interested public.

Due to necessary reductions in research expenditures, no new field programs were initiated in 1981. However, this did afford the Project Section the opportunity to complete publications emanating from previous field work in Nova Scotia.

Therefore, a number of the contained reports are abstracts of full publications to be released in the immediate future.

J. A. Garnett, Ph.D., P. Eng.
Director, Mineral Resources

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SYDNEY AND PICTOU COALFIELDS

K. S. Gillis

SYDNEY COALFIELD

In the Sydney coalfield evaluation of areas holding potential near surface coal resources continued as part of the provincial coal inventory. Previous exploratory drilling, conducted by the Coal Section, outlined potential sites which were selected for further evaluation.

One site (Fig. 1), a 3000 m section on the Gardiner seam lying to the immediate east of the Sydney airport, was selected for detailed investigation. This area was selected because past investigations indicated approximately 2.2 million tonnes of potential coal for stripping. At a 10:1 ratio, analyses indicated ash and sulphur to be 11.7 per cent and 3.0 per cent respectively with a calorific value of 30.2 MJ/kg. Site investigation is in progress at the time of writing.

This stage of site investigation to determine coal quality and quantity consists of diamond drilling using Longyear Model 38 drills equipped for drilling HQ size core. All holes were geophysically logged with gamma ray and density probes. Fifteen holes will be drilled on this section for an approximate total of 500 m of core. Proximate analyses, sulphur and calorific values are determined for all coal intersections.

PICTOU COALFIELD

In the Pictou coalfield investigations were conducted on a site at Thorburn (Fig. 2) which was considered to hold a potential near surface resource. Past exploration, by the Coal Section, indicated that approximately 1 million tonnes of thermal coal could be mined on the McKay seam at an approximate strip ratio of 10:1. Analyses show the coal to average 20 per cent ash, 2.5 per cent sulphur with a calorific value of 27.0 MJ/kg.

Site investigation for quality and quantity consisted of diamond drilling using Longyear Model 38 drills equipped for drilling NQ size core. All holes are geophysically logged with gamma and density probes.

Drilling is still in progress, at time of writing, and it is expected that 12 holes will be drilled for an approximate total of 400 m of core. Coal intersections are sampled and sent for proximate analyses as well as sulphur and calorific value.

FUTURE WORK

Assessment of near surface coal will continue and will include diamond drilling and bulk sampling of selected coal areas for coal quality and beneficiation purposes.

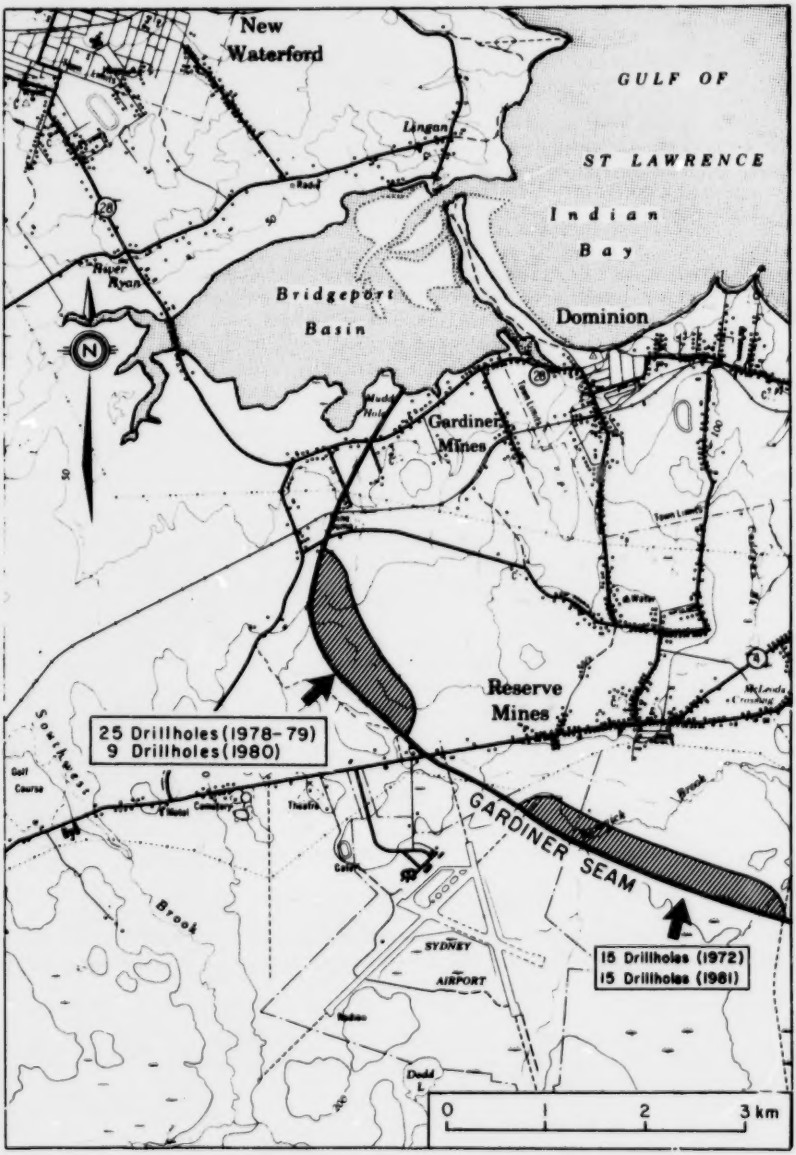

Figure 1. Location of drillholes for Gardiner seam, Sydney coalfield.

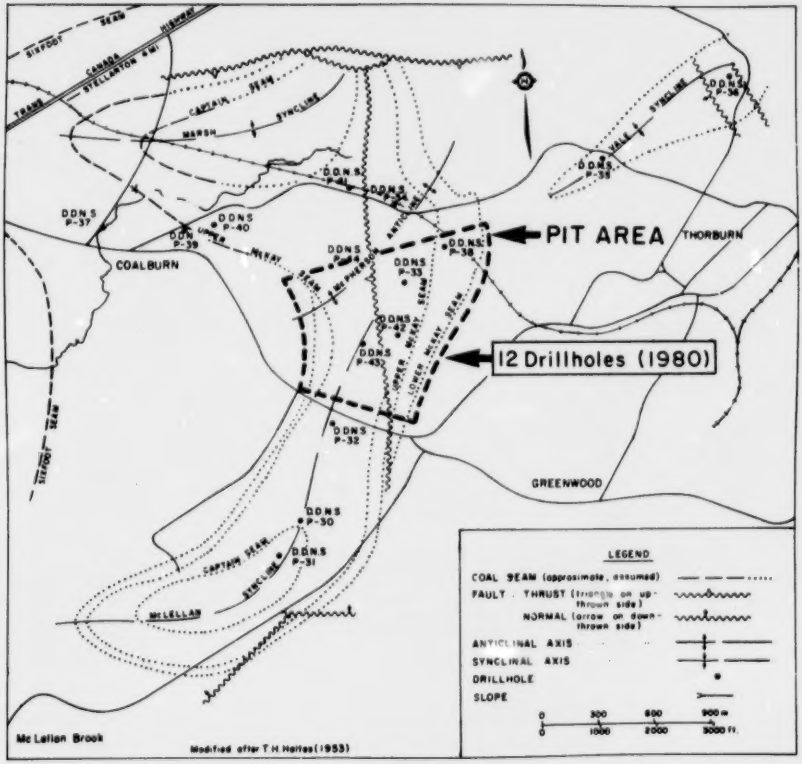

Figure 2. Location of boreholes for near surface coal, Thorburn, Pictou County.

CUMBERLAND COAL BASIN

J. H. Calder

The second phase of diamond drilling on the Rodney and McCarthy seams in the Springhill coalfield comprises the bulk of work performed by the Coal Section in the Cumberland coal basin. In the greater Oxford area, BP Canada (Coal) completed the first phase of an extensive diamond-drilling program and infill mapping was undertaken by the Coal Section to supplement the 1:10 000 mapping conducted in 1980. Through these efforts, a great deal of stratigraphic and structural information pertaining to the Springhill coalfield and Cumberland coal basin has been acquired.

GEOLOGICAL AND MINING EVALUATION AT SPRINGHILL

The exploration program on the Rodney and McCarthy seams, which were identified in 1980, was continued in 1981. Diamond drilling, using two and later three drills, took place from February through June with a total of 3789.28 m drilled. Novaco Ltd. was assigned a managerial role in the program and enlisted the services of Norwest Resource Consultants of Calgary, Alberta. Norwest became actively involved on site in April and prepared a six volume geological evaluation of the Rodney and McCarthy seams in the axial region of the Springhill coalfield. Detailed seam profiles, structural interpretation and core logging constituted the most time consuming aspects of the investigation along with report preparation.

Diamond drilling concentrated on closing the drillhole spacing on the property to better define the structure. As drilling proceeded, it became apparent that the structure was either more complex or at least different than perceived at the close of 1980's investigation. Norwest's interpretation of the structure indicates folding within the bounding faults.

As investigation of the outcrop proceeded, the use of shallow triconed drillholes lined with plastic tubing was implemented, but later abandoned due to tube insertion problems and uncertainties in seam correlation. Trenching, using a track-mounted John Deere backhoe, was conducted in May and June, aiding greatly the structural interpretation of the subcrop area (Fig. 1).

It should be noted that the 1981 program concentrated chiefly on the mineability of the area outlined in 1980. Additional reserves may exist down dip. At time of writing, the site has been cleared by Novaco, and excavation of an open-pit box cut is expected to proceed in the immediate future, with subsequent drivage underground. The majority of reserves lie within the Rodney seam; engineering constraints on the mining of the underlying McCarthy seam render only a minor reserve which is nevertheless proposed to be mined, in conjunction with the Rodney seam.

The braidplain association proposed as a depositional model for the southern portion of the Springhill coalfield (Calder, 1980) has generally been supported by diamond drilling in 1981. A paper summarizing the revised stratigraphy in the Springhill coalfield is being prepared.

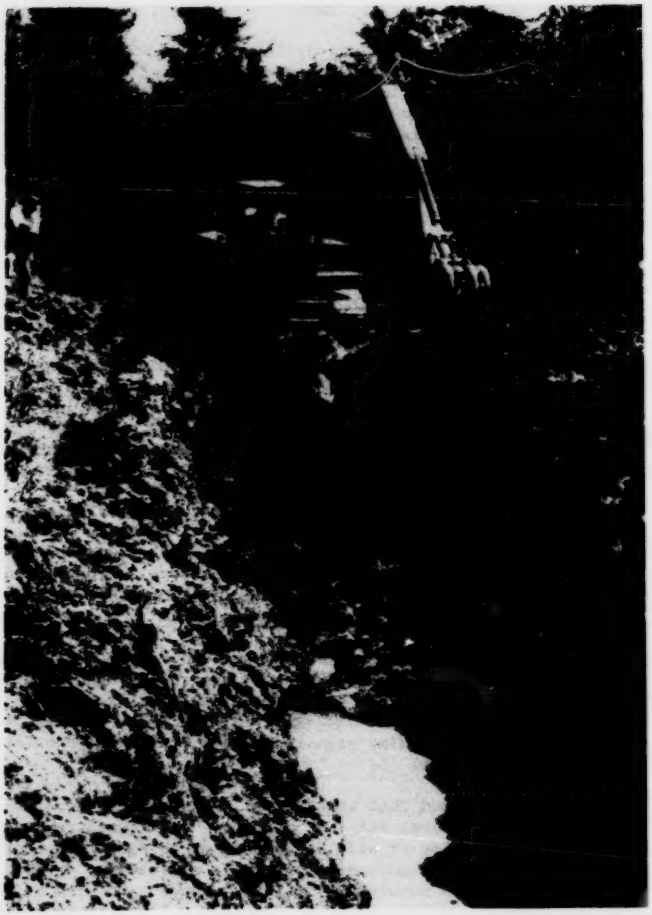

Figure 1. Excavation of the Rodney seam in trench III.

DEPOSITIONAL AND STRATIGRAPHIC CONCEPTS IN THE CUMBERLAND COAL BASIN

Insights gained into the stratigraphy at Springhill can be applied elsewhere in the Cumberland coal basin. These concepts affect only a minor part of the entire sedimentary sequence constituting the Cumberland coal basin. However, the drilling conducted by BP Canada (Coal) east of Springhill near Oxford has raised many important questions pertaining to previous stratigraphic interpretations of the strata comprising the Riversdale, Cumberland, and Pictou Groups. These data, supported by assimilation of other data pertaining to the coal basin, have led to some preliminary concepts of coal deposition and basin stratigraphy.

The reconstructed stratigraphic section of the Cumberland coal basin through Springhill and Fenwick (Fig. 2) illustrates some subdivisions of the Cumberland Group and their perceived relationships. The correlation of lensing sequences of strata is made difficult because of the scarcity of data due to the depth of strata and lack of outcrop of subsurface units limiting information on the transitional nature of these units. A roughly linear belt of pelecypod-bearing dark grey to black argillaceous calcareous sediments paralleling the Cobequid uplands in a central basin position apparently reflects a shallow water shoreline environment.

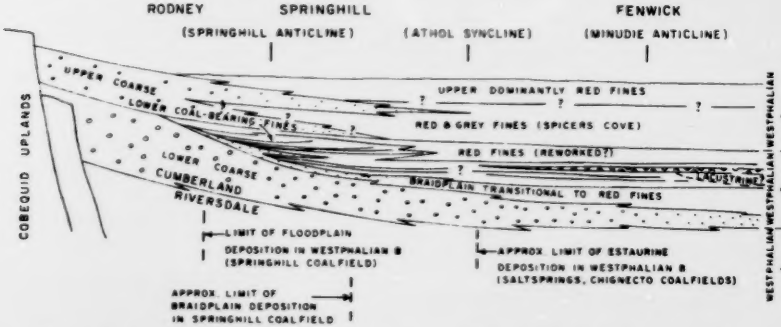

Figure 2. Reconstructed stratigraphic section of central Cumberland coal basin.

Duff and Walton (1973) suggested a marginal marine environment with no true marine transgression. They cited ostracod- and bivalve-bearing limestones above the coals as representing an abortive marine transgression. In the section (Fig. 2) a lacustrine environment is portrayed, although estuarine conditions are indeed possible if marine incursions existed further north, as alluded to by Duff and Walton (1973). This "shoreline" zone includes the Joggins-Chignecto, Saltsprings, and Roslin coal areas. A gradational environmental change controlled by the Cobequid hinterland and by maximum subsidence centrally is envisaged from the Springhill area northward. An assumed deeper water (lacustrine or eustuarine) environment may have existed in the vicinity of the present Minudie Anticline. Assuming a continuous transitional sequence (see below),

the Minudie Anticline would not have been topographic high during middle Westphalian B time. Fossiliferous shales, mudstones and fine grained sandstones on the south flank of the anticline suggest a low relief during deposition. Depositionally, a transformational sequence is envisaged as follows, from the Cobequid upland basinward:
alluvial fan ->braidplain ->floodplain ->delta(?) ->lake or estuary

A paper outlining some depositional models for the Cumberland coal basin is being prepared.

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1980: Geological appraisal of coal resources in the Rodney seam of the Springhill coalfield (draft report); Nova Scotia Department of Mines and Energy, Open File Report 456, 38 p.

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1973; Carboniferous sediments at Joggins, Nova Scotia; 7th International Congress of Carboniferous Stratigraphy and Geology, Compte Rendu, Kerfeld, 1971, v. 11, p. 365-379.

PEATLAND INVENTORY

A. R. Anderson and W. Broughm

Only within the past decade or so has peat been recognized as a viable local energy resource in North America. It represents a safe, clean, indigenous energy resource that can be used as an alternate means of energy production.

Nova Scotia has an estimated 240 000 ha of peatland (Singhroy, 1980) with the largest concentrations located in Queens, Shelburne and Yarmouth Counties as well as Guysborough County and eastern Cape Breton Island (Fig. 1).

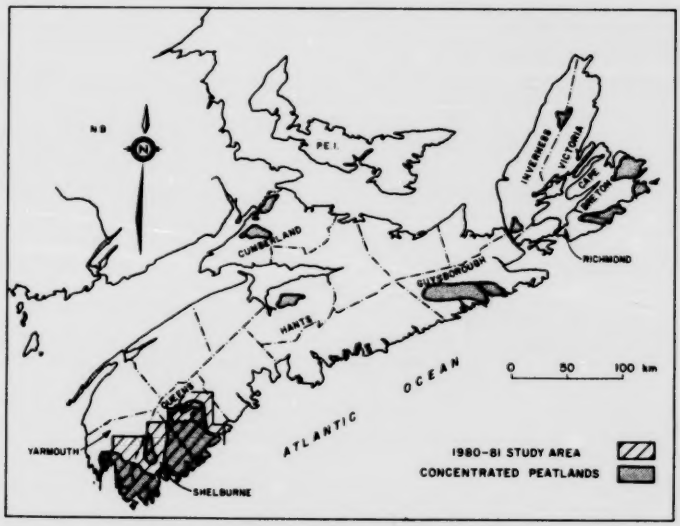

Figure 1. Location map showing peatland areas in Nova Scotia and the 1980/81 study area.

In stride with Nova Scotia's goal for "energy independence", the Energy Resources Division is engaged in a program to assess the peat resources of the Province.

A photo study carried out in 1979 indicated several large concentrations of peat deposits throughout the Province; the most notable in Yarmouth, Shelburne and Queens Counties. The 1980 field season involved a reconnaissance program of 3600 ha of peatlands throughout the

study area (Fig. 2). Information gathered in the 1979-1980 study showed the area of central Queens County to contain significant deposits with a potential for energy production. The 1981 field program assessed the largest and most accessible peatlands in this region. In addition, specific deposits in Halifax County were assessed to provide information for possible horticultural peat production.

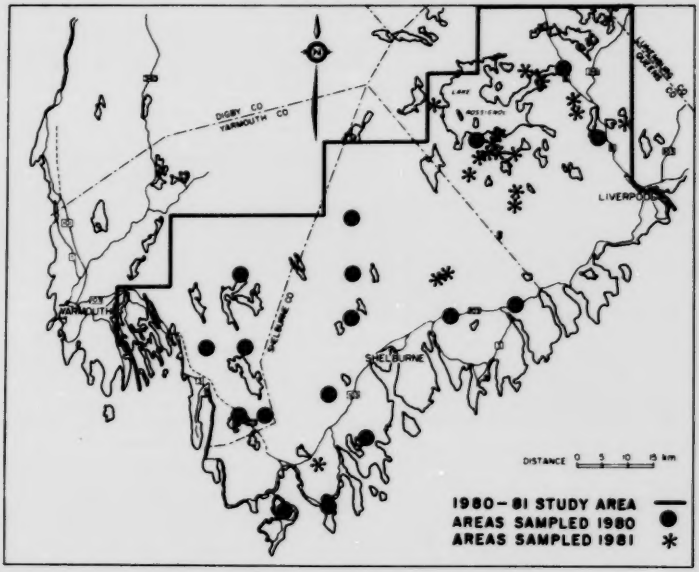

Figure 2. Areas sampled during 1980 and 1981 field seasons.

Peatlands in southwestern Nova Scotia are generally raised basin bogs confined by till deposits and exposed bedrock. Often the bogs have a cover of trees and dense shrubs. Other open bogs are usually patterned by ericaceous shrubs and stunted trees and *Scirpus cespitosus* lawns.

The peat within the deposits is a moderately humified *Sphagnum* peat (Von Post scale 4.5 ranging 3-8; Korpijaakko and Pheeney, 1977) often overlying a basal layer of a higher humified *Sphagnum* peat (5-9) or a thin layer of slightly humified (3-5) *Carex* peat.

The deposits in Halifax County are raised basin bogs that have a predominantly *Scirpus* cover, with a patterned occurrence of small ericaceous shrubs. The peat in these bogs is a slightly humified (2-4),

pure *Sphagnum* peat with *Scirpus* roots permeating the upper horizons. Beneath this is a very thin and scattered occurrence of *Carex* peat and basal peat layers.

As of December 31, 1981 approximately 6900 ha have been added to the 3600 ha surveyed in 1980. From thickness data gathered this season it is estimated that 60 per cent of the peat found in the sampled deposits falls into the fuel peat category (H5-10). Of the deposits sampled in Halifax County, 90 per cent of the volume falls into the horticultural peat category (H1-4).

Actual volumes and ratios are still under revision and should be available in the summary report being prepared for 1981 (Anderson and Broughm, in preparation).

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Anderson, A. R. and Broughm, W.
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1977: Peatland survey methods; New Brunswick Department of Natural Resources, Mines and Geology Branch, Topical Report No. 77-4.

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EXPLORATION ACTIVITY IN NOVA SCOTIA - 1981

J. M. Bingley

Exploration activity in Nova Scotia was at a very high level in early 1981, but declined in the third quarter to finish the year only slightly above 1980 levels. This downward trend mirrored the general decline in our national economy and a provincial decision to halt issuance of special uranium exploration licences.

Exploration dollars spent in search of gold, base metals, potash and onshore coal reached an all time high while uranium expenditures fell slightly short of 1980 levels. Table 1 indicates a downward trend in new and renewed claim staking.

BASE METALS (Figure 1a)

Tin-tungsten exploration in the Devonian granites and Cambro-Ordovician wackes of southwestern Nova Scotia has been at a high level for several years with Shell Canada Resources Limited leading the way and finding the first potential tin deposit. Esso Minerals Canada Limited has also been heavily involved in exploration for tin as have Lacana Mining Corporation, Kidd Creek Mines Limited (Aquitaine), Placer Mining Corporation and Patino Mines (Quebec) Limited.

It is anticipated that exploration for tin will continue at a high level through 1982 although a critical factor may be the decision by Shell whether or not to develop its tin deposit at East Kemptville at this time.

Exploration for *copper, lead, zinc* and associated minerals was active although metal market weaknesses appear to have curtailed some expected late season drilling.

In the northeastern mainland area Esso, Gulf Minerals Canada Limited, Preuvier Mines Limited, Maritime Explorations Limited (MEX), Cominco Limited and Granges Exploration AB carried out extensive programs in areas underlain by Carboniferous age marine and terrestrial sedimentary rocks. Esso, Noranda Mines Limited and Sulpetro Minerals Incorporated conducted surveys in the early Paleozoic age rocks of the Antigonish Highlands and in the "Meguma" sedimentary rocks of the eastern mainland.

Most base metal exploration on Cape Breton Island took place in the Hadrynian-Early Paleozoic rocks of the George River and Fourchu Groups and intruding granites. Amax Potash Limited, French Road Explorations and Noranda all worked in the volcanogenic terrane near Gabarus Bay. Sulpetro, MEX, Dome Mines Limited, Duval Corporation of Canada and Lacana explored extensively in the highland regions of northwestern Cape Breton Island.

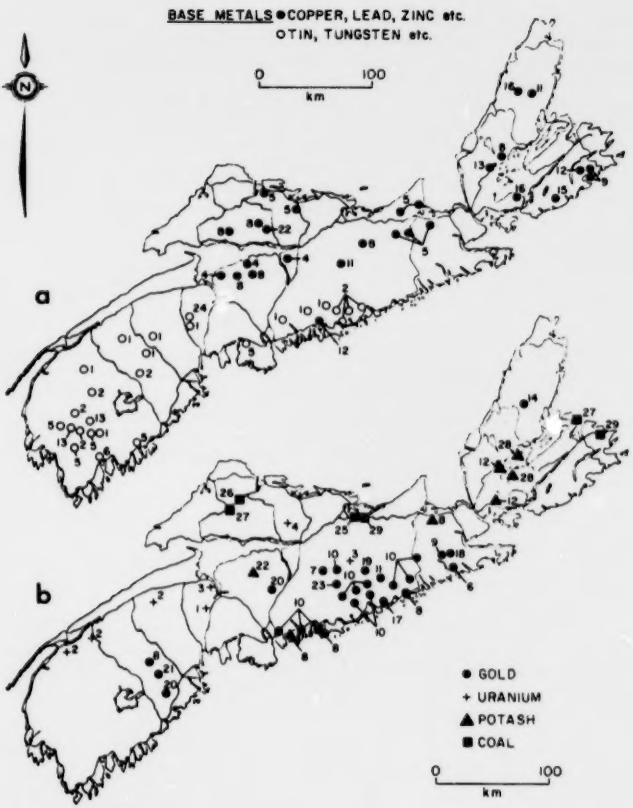
URANIUM (Figure 1b)

Extensive uranium surveys were undertaken by four companies in 1981. Shell, Kidd Creek (Aquitaine), and Saarberg Interplan Canada

Table 1. Mineral exploration trends in Nova Scotia.

	1976	1977	1978	1979	1980	1981
Exploration Expenditure ($)*	1 600 000	3 800 000	5 900 000	4 700 000	7 564 000	8 441 270.30
Total Licences Issued	1 489	2 894	2 393	1 841	2 559	1 896
Claims Recorded						
Base Metal	35 434	70 936	38 597	40 497	88 703	72 907
Uranium	21 526	48 721	31 978	30 920	25 483	6 225
Salt, Potash	224	887	1 148	2 256	13 505	1 155
No. Mineral Assessment Repts.	70	95	132	126	140	157

*Based on assessment work submitted to Department of Mines and Energy each year.



1. Kidd Creek
2. Shell
3. Saarberg
4. Gulf
5. Esso
6. Patino
7. Placer
8. MEX-Cuvier-Preuvier
9. French Road Exploration-Louisbourg Property Holdings
10. Paneast-Northumberland
11. Sulpetro
12. Noranda
13. Lacana
14. Dome
15. Amax
16. Duval
17. Harrigan Associates
18. Seabright Resources
19. Canadian Nickel
20. O. Pulsiver et al.
21. F. Rhodenizer
22. Cominco
23. Sherritt Gordon
24. Norcen
25. Brinco-Suncor
26. BP
27. Novaco
28. Irving-Chevron
29. Nova Scotia Department of Mines & Energy

Figure 1a. Base metal exploration activity in Nova Scotia, 1981.
1b. Exploration activity for gold, uranium, potash and coal in Nova Scotia, 1981.

worked in southwestern Nova Scotia while Gulf concentrated on the Cobequid Highlands area of Cumberland and Colchester Counties. The geological environments of interest were the Ordovician-Silurian sedimentary rocks and the Devonian granitic rocks that occur to the south of the Annapolis Valley and Minas Basin, the Carboniferous age sedimentary rocks south of the Minas Basin and the middle Paleozoic sedimentary-volcanic complex to the north of the Minas Basin.

Although these companies located numerous interesting uranium occurrences and, in the case of Kidd Creek, a potential ore body, all projects were suspended in early autumn. This action was due to the provincial government's decision to place a moratorium on the issuing of new or renewable uranium exploration licences.

GOLD (Figure 1b)

Gold exploration in the Cambro-Ordovician Meguma Group rocks was above average in 1981 with almost all previously mined areas solidly staked as well as most of the Meguma Group. Humus horizon soil sampling, VLFEM surveying and proton magnetometer surveying are the methods used by most companies to locate gold-bearing structures although other electrical methods have been found to work well in some localities.

Some of the more active companies were Northumberland Mines Limited, Paneast Explorations Limited, Sherritt Gordon Mines Limited, Louisbourg Property Holdings, Sulpetro, Placer, Baker Talc Limited, Seabright Resources Limited, Harrigan Associates, Canadian Nickel Company Limited and Comiesa Corporation.

Both Harrigan Associates and the Louisbourg Property Holdings-Bartex joint venture have gravity type beneficiation plants to bulk test deposits at Harrigan Cove and Mile Lake respectively. Northumberland Mines Limited has a one hundred ton per day cyanide mill in operation for bulk testing its Cochrane Hill deposit.

The outlook for continuation of 1981's level of activity in the gold camps is very optimistic.

POTASH (Figure 1b)

The Windsor Group rocks of central Cape Breton Island have been extensively surveyed and drilled by Noranda and the Irving-Chevron joint venture. Although potash was encountered in several areas, the unexpected complexity of the salt-bearing formations has necessitated at least a temporary halt to their drilling programs.

In the central and eastern mainland areas Cominco and Cuvier Mines Limited respectively conducted baseline geophysical surveys for the purpose of delineating drilling targets.

COAL (Figure 1b)

B. P. Canada conducted a major wildcat drilling program for coal in the Oxford area just east of the Springhill coalfield.

Brinco Mining Limited and Suncor Incorporated are jointly conducting a deep drilling program in the Stellarton coalfield using two 4000 feet capacity wireline drills.

Novaco, a provincial crown corporation, is developing an open-pit underground mine at Springhill and is doing development drilling in the vicinity of its open-pit operation at Point Aconi in the Sydney coalfield.

The Nova Scotia Department of Mines and Energy has been drilling for near surface coal in the Stellarton coalfield and near Glace Bay in the Sydney coalfield.

MINERAL INVENTORY

N. A. Lyttle and J. Gillespie-Wood

Our activities over the past year have concentrated upon inputting backlogged document data into GEOSCAN, the national database for geological information. The purpose behind this updating of the GEOSCAN database is to allow us to initially produce four new computer-generated indexes to Nova Scotia Department of Mines and Energy documents, namely: an updated and revised Index to Assessment Reports; a Keyword Index to Assessment Reports; an Index to Publications, Open File Reports and Theses; and an Index to Drillhole and Well Data. These four indexes are all in press, and described in more detail below.

INDEX TO ASSESSMENT REPORTS (REPORT 81-4)

This publication is in press and should be available by the end of March 1982, both in hard copy and microfiche, and will be entitled *Report 81-4, Index to Assessment Reports 1864-1980*, by *Norman A. Lyttle and Janet Gillespie-Wood*. This report is a bibliographic index covering the period 1864 up to the end of 1980, to data contained in the non-confidential exploration assessment reports of the Nova Scotia Department of Mines and Energy. The purpose of this index is to provide sources of assessment report data, by title only; the index does not provide the actual assessment report data itself. The assessment report data must be obtained from the actual sources cited in this index. All the Assessment reports cited in *Report 81-4* have been microfilmed and can be consulted in the libraries of the Halifax and Stellarton offices of the Department. They can also be purchased on microfiche from Precision Microfilming Services, 6061 Young Street, Halifax, Nova Scotia, B3K 2A3 (902 455-5451).

Report 81-4 supersedes the previously published *Report 77-2, Index to Mineral Assessment Reports*, by *Diane J. Gregory*, and it should be used in place of *Report 77-2*. Annual supplements to *Report 81-4* will be produced, and at the end of an appropriate time interval these supplements will be combined and a new index to assessment reports covering that specific time interval will be published. The supplement for 1981 is presently under preparation and should be ready for release by mid-1982.

KEYWORD INDEX TO ASSESSMENT REPORTS 1864-1980 (REPORT 81-5)

This publication is in press and should be available by the end of March 1982, on microfiche only, and will be entitled *Report 81-5, Keyword Index to Assessment Reports 1864-1980*, by *Norman A. Lyttle and Janet Gillespie-Wood*. Concepts or keywords are lists of the most relevant and important terms, stored in the GEOSCAN data base, which are used to more fully describe the subject content of each assessment report. For each assessment report, the keywords include the title information as well as terms describing NTS areas, mineral and rock names, types of mineralization, types of exploration surveys, diamond drilling, chemical analyses, assays etc. In *Report 81-4*, these keywords have not been included with each report title, since their inclusion would substan-

tially add both to the physical size of the index and to its production and retailing costs. However, a keyword index to all the assessment reports listed in *Report 81-4* has been produced. This keyword index is an alphabetic listing of all keywords used to describe all the assessment reports in *Report 81-4*, cross-referenced against the assessment report titles in which they occur. In effect, the keyword index allows the complete assessment report records to be searched for any particular keyword. For example, all assessment reports describing gold exploration would be found listed as a series of assessment report titles against the keyword "gold" in the alphabetic listing of keywords.

INDEX TO PUBLICATIONS, OPEN FILE REPORTS AND THESES (REPORT 81-6)

This publication is in press and should be available by the end of March 1982, both in hard copy and microfiche, and will be entitled *Report 81-6, Index to Publications, Open File Reports and Theses 1862-1980*, by *Norman A. Lyttle and Janet Gillespie-Wood*. This report is a bibliographic index, covering the period 1862 up to the end of 1980, to information contained in the publications and open file reports of the Nova Scotia Department of Mines and Energy and to university theses on geoscience of Nova Scotia. In addition to containing indexes to publications, open file reports and university theses, *Report 81-6* also contains an author index and a geographic NTS index to all the documents cited in this report. The purpose of this index is to provide sources of publications, open file reports and theses information, by document title only; the index does not provide the actual document information itself. The actual information must be obtained from the document sources cited in the index.

The document titles cited in *Report 81-6* are the titles of all Nova Scotia Department of Mines and Energy publications (acts and regulations, annual reports, bulletins, economic geology series, information series, memoirs, miscellaneous publications, pamphlets, papers, published maps, reports and reports of activities) and open file reports (unpublished information from various sources on geoscience of Nova Scotia), as well as university theses (B.Sc., M.Sc. and Ph.D.) on geoscience of Nova Scotia, available for compilation from 1862 up to the end of 1980.

Report 81-6 is the first combined index to publications, open file reports and university theses published by the Department. *Report 81-6* supersedes the previously published *Report 78-3, Index to Open File Reports*, by *Diane J. Gregory*, and it should be used in place of *Report 78-3*. At the end of an appropriate time interval, when sufficient, additional publications, open file reports and theses have accumulated, a new index to that data will be published, covering that specific time interval. If the volume of new publications, open file reports and theses warrants it, annual supplements to this index may be published.

The publications and open file reports cited in *Report 81-6* can be consulted in the libraries of the Halifax and Stellarton offices of the Department. The publications can be purchased from the Department libraries, and the open file reports can be purchased on microfiche from Precision Microfilming Services, 6061 Young Street, Halifax, Nova Scotia, B3K 2A3 (902 455-5451). At this time of writing, a small number of university theses are available for consultation in the library of the

Halifax office. It is anticipated that in the future, all theses cited in *Report 81-6* will be available on microfiche for consultation in the library of the Halifax office.

INDEX TO DRILLHOLE AND WELL DATA 1862-1980 (REPORT 81-7)

This publication is in press and should be available by the end of March 1982, both in hard copy and microfiche, and will be entitled *Report 81-7, Index to Drillhole and Well Data 1862-1980*, by *Norman A. Lyttle and Janet Gillespie-Wood*. This report is a bibliographic index, covering the period 1862 up to the end of 1980, to information concerning drillhole and well data found in the non-confidential exploration assessment reports, publications and open file reports of the Nova Scotia Department of Mines and Energy. The purpose of this index is to provide sources of drillhole and well data, by document title only; the index does not provide the actual drillhole and well data itself. The actual data must be obtained from the document sources cited in the index.

The document titles cited in *Report 81-7* are the titles of all the exploration assessment reports, publications (NSDME acts and regulations, annual reports, bulletins, economic geology series, information series, memoirs, miscellaneous publications, pamphlets, papers, published maps, reports and reports of activities), and open file reports (unpublished information from various sources on geoscience of Nova Scotia) held by the NSDME that contain data (information) on drillholes and wells, both onshore and offshore. The majority of titles refer to data on diamond drilling reported in assessment reports concerned with mineral exploration on land.

Report 81-7 is the first index to drillhole and well data published by the Department. At the end of an appropriate time interval, when sufficient additional drillhole and well data has accumulated, a new index to that data will be published covering that specific time interval. If the volume of new drillhole and well data warrants it, annual supplements to this index may be published.

The assessment reports, publications and open file reports cited in *Report 81-7* can be consulted in the libraries of the Halifax and Stellarton offices of the Department. The assessment reports and open file reports can be purchased on microfiche from Precision Microfilming Services, 6061 Young Street, Halifax, Nova Scotia, B3K 2A3 (902 455-5451). The publications can be purchased from the Department libraries.

PUBLICATIONS IN PREPARATION

At this time of writing, an additional five publications, relevant to the above described publications, are in preparation. These publications in preparation are expected to be available by mid-1982, and will be entitled as follows: Index to 1981 Open Assessment Reports; Keyword Index to 1981 Open Assessment Reports; Keyword Index to NSDME Publications 1862-1980; Keyword Index to NSDME Open File Reports 1862-1980; and Keyword Index to Geological Survey of Canada Documents on Nova Scotia to 1980.

MICROFILMING OF ASSESSMENT REPORTS AND OPEN FILE REPORTS FOR 1981

During 1981, an additional 133 assessment reports and 30 open file reports became open. All of these reports have been microfilmed and can be purchased on microfiche or hard copy (produced from microfilm) from Precision Microfilming Services, 6061 Young Street, Halifax, Nova Socita, B3K 2A3 (902 455-5451). Lists of these respective reports are published in this Mineral Resources Division Report of Activities for 1981.

AGGREGATE RESOURCES OF CAPE BRETON ISLAND

W. J. Wright

The program for 1980 identified land based aggregate deposits and determined their quality within a 50 km radius of Sydney. The 1981 program continued this investigation expanding the study area to include the entire Island of Cape Breton. The increase in the number of potential aggregate reserves in Cape Breton is shown in Figure 1.

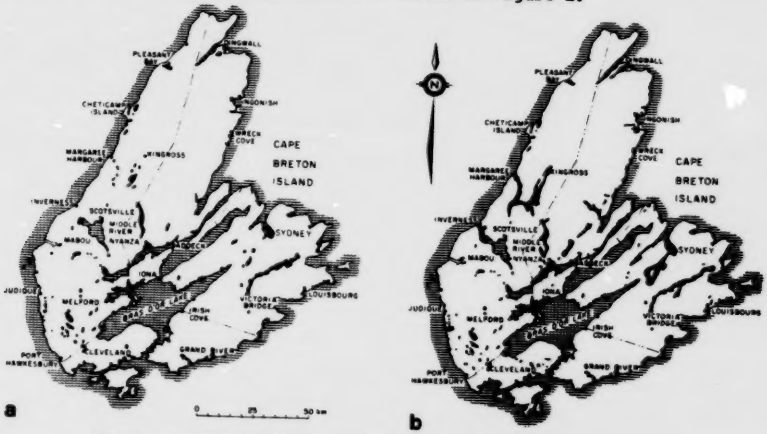


Figure 1a. Potential deposit areas outlined before 1979.
1b. Potential deposit areas outlined to the present.

These deposits were outlined using airphoto interpretation and extensive field work. Valuable information was obtained from existing diamond-drill holes, water-well logs, and sample analyses. Surficial maps prepared by the hydrogeological staff of the Nova Scotia Department of the Environment in Sydney were used to delineate several granular aggregate deposits and the Department of Transportation provided considerable aggregate quality data.

The Department of Mines and Energy has tested several sand deposits in Cape Breton. The results show that high quality natural fine aggregate deposits are not plentiful on the Island. In some cases aggregate producers must haul sand from deposits 50 to 150 km from their plants.

Benefication by means of washing, screening and blending is usually necessary to upgrade most of the granular aggregate materials to asphalt or concrete specifications.

In 1980, aggregates (crushed stone, sand and gravel) represented 45 per cent of the total production of industrial mineral commodities in

Cape Breton (Fig. 2b). This translates into a figure of approximately $3.3 million or 29 per cent of the total value of Cape Breton's industrial minerals produced that year (Fig. 2a).

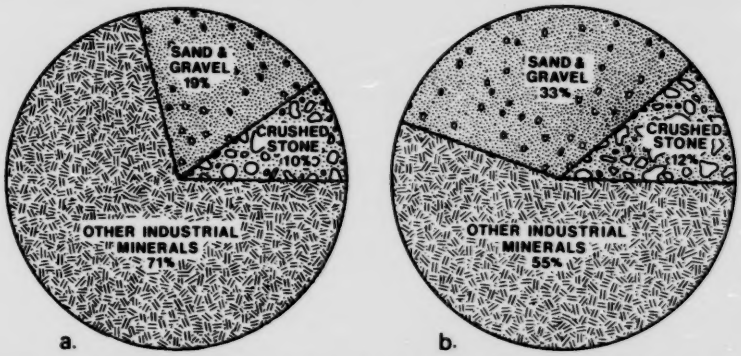


Figure 2a. Percentage dollar value of sand and gravel, crushed stone, and other industrial minerals produced in Cape Breton Island, 1980.
2b. Percentage production in tonnes of sand and gravel, crushed stone, and other industrial minerals in Cape Breton Island, 1980. (Information Source: NSDME)

Aggregate production from rock quarries has not increased substantially over the past ten years, although several quarry sites have been assessed. A limestone mapped in the St. Peter's area of Richmond County and a durable schist found at Beinn Scalpie, Victoria County are suitable for both concrete and asphalt production.

Alternate sources of natural aggregate such as slag, coal mining waste and recycled asphalt which are not now contributing significantly to the aggregate budget of Cape Breton are presently being investigated.

PRINCIPLES OF TECTONIC MAPPING BASED UPON PLATE TECTONIC THEORY*

J. D. Keppie

ABSTRACT

A tectonic map attempts to portray the origin and evolution, in space and time, of a region. Plate tectonic concepts have been successfully applied to the Phanerozoic and Proterozoic. Their application to the Archean is still under debate. The advent of plate tectonics heralds a new generation of tectonic maps for most of the earth's surface, namely that part underlain by Phanerozoic and Proterozoic rocks. It may be necessary to base tectonic mapping of Archean terrains upon an alternative tectonic model. In tectonic mapping using plate tectonic theory, three hierarchical categories are recognized: zones, stages and elements.

A *tectonic zone* is defined as an area characterized by the nature of the underlying crust (continental, transitional or oceanic) and is bounded in time by orogenies.

A *tectonic stage* is defined as a phase of tectonic development forming part of a tectonic zone and characterized by an association of tectonic elements. The following stages are recognized: stable, rift, atlantic, pacific and transpression.

A *tectonic element* is defined as a certain, specific, well-defined tectonic environment and characterized by a distinct tectono-stratigrafic or tectono-plutonic rock unit which is part of a tectonic zone or stage, e.g. continental shelf, forearc basin, marginal basin, etc.

The scale of the tectonic map controls the degree of subdivision depicted. Thus, on small scale maps only tectonic zones may be shown, intermediate scale maps may include tectonic zones, stages and possibly combinations of elements, and large scale maps can portray all three categories.

Structural elements including fold traces, foliations and faults, are also plotted on a tectonic map as are structure contours in undeformed or mildly deformed basins and the axes of gravity and magnetic anomalies.

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*The Geological Association of Canada, Abstracts, v.6, p. A-30 and the Nova Scotia Department of Mines and Energy, Paper 81-4, in press.

TECTONICS OF NOVA SCOTIA - A REVIEW*

J. D. Keppie

The geological record in Nova Scotia is divisible into seven distinct tectono-stratigraphic packages or tectonic provinces, each characterized by the nature of the crust: continental, transitional, or oceanic (the latter not present in Nova Scotia).

NORTHERN NOVA SCOTIA	SOUTHERN NOVA SCOTIA
Triassic & Cretaceous Rift & Coastal Plain Rocks	
HERCYNIAN OROGENY	
Carboniferous Magdalen Basin & Shelf Deposits	
Mid-Late Devonian Molasse	ACADIAN OROGENY
Silurian Shelf & Basin Deposits	
Late Ordovician Rift Rocks	
TACONIAN OROGENY	
Cambro-Ordovician Shelf Deposits	Meguma Trough Deposits
Early & Mid-Cambrian Rift Rocks	
CADOMIAN OROGENY	
Late Hadyrnian Island Arc Complex	Continental Crust,
George River Shelf Deposits	(age unknown)
MICMACIAN OROGENY	seismic velocity =
Basement Complex	5.4/6.25 km/sec.

The effects of each orogenic event in Nova Scotia vary from a regional uncomformity in the case of the Taconian Orogeny through deformation and plutonism in the Hercynian Orogeny to an association of molasse, deformation, metamorphism and plutonism in the Acadian and Cadomian Orogenies. These may be interpreted in terms of distance from the locus of the orogeny and the inferred plate tectonic setting involved in the genesis of the orogeny.

*Geological Society of America, Northeastern Section, Abstracts with Programs, 1981, v.13, no.3, p.140

OBSERVATIONS ON THE ICHNOLOGY OF THE MEGUMA GROUP (?CAMBRO-ORDOVICIAN) OF NOVA SCOTIA*

R. K. Pickerill[1] and J. D. Keppie

The trace fossils *Arenicolites variabalis*, *Circulichnis montanus* and *Paleodictyon (Glenodictyum) cf. imperfectum* from the ?Cambro-Ordovician Meguma Group of Nova Scotia are described in detail. The significance of the occurrence of each of these ichnospecies is also noted. The environmental and stratigraphic ranges of *A. variabalis* are extended respectively to 'deep water' and the Ordovician; the stratigraphic range of *C. montanus* is extended to the Ordovician and its presence in the Meguma Group to date represents the first and only recording of the species in the western hemisphere; *P. cf. imperfectum* provides additional evidence that at least part of the Goldenville Formation is Ordovician.

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* Maritime Sediments and Atlantic Geology, 17, 1981, p. 130-138.

[1] Department of Geology, University of New Brunswick, Fredericton, New Brunswick

THE APPALACHIAN COLLAGE*

J. D. Keppie

The Appalachians may be divided into two tectonic settings: autochthonous and allochthonous. The autochthonous rocks along the western margin consist of a Grenvillian cratonic basement overlain by rift and continental shelf sediments followed by flysch derived from overthrust allochthons. The allochthonous collage can be divided into two categories: 1) overthrust, allochthonous terranes, and 2) allochthonous terranes. (1) The overthrust, allochthonous terranes are allochthonous terranes which have been thrust over the autochthonous rocks. In the northern and central Appalachians, the overthrust allochthons consist essentially of continental rise sediments and oceanic crust which probably originated close to the North American craton. In the southern Appalachians, the overthrust allochthonous terranes occur between the Central Piedmont and Central Blue Ridge Sutures and include both proximal and exotic terranes. (2) The allochthonous terranes are essentially microplates characterized by a distinct, yet internally homogeneous, geological record, are bounded by fundamental discontinuities and sometimes surrounded by flysch and molasse. The allochthonous terranes range from pieces of oceanic crust and fragments of island arcs to microcontinents of both exotic and North American origin. They generally occur east of the easternmost limit of Grenvillian cratonic basement defined by the Central Piedmont-Martic-Camerons-Brompton-Deer Lake Line.

It appears that the allochthonous terranes were emplaced by progressive accretion of single or amalgamated terranes to the eastern margin of North America. As a consequence of oblique collision, the initial docking was generally followed by transcurrent movements. Palaeomagnetic data show that a late stage of such movements involved at least 1500 km of sinistral movement for southeastern Atlantic Canada and adjacent U.S.A.

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* Terra Cognita, Uppsala Caledonide Symposium, v.1, no.1, p.54.

POLYMETALLIC MINERALIZATION IN THE ENDO- AND EXO-CONTACT OF THE WEDGEPORT PLUTON, YARMOUTH COUNTY, NOVA SCOTIA, CANADA*

J. D. Keppie and A. K. Chatterjee

In the area south of Yarmouth, the Wedgeport pluton is intrusive into deformed and regionally metamorphosed turbidites of the Goldenville Group. Finely banded psammites and pelites are overlain by more massive, classical turbidites suggesting a prograding fan deposit progressing upwards from distal to suprafan environments. A layer-parallel foliation is present throughout the area. During the Acadian Orogeny, these rocks were deformed by upright, north-south tight folds associated with cleavage fans, bedding/cleavage intersection and flexural-slip lineations. Regional low pressure metamorphism followed the folding, producing andalusite-cordierite ± staurolite ± garnet ± biotite-muscovite-quartz in the pelitic units; i.e. low amphibolite facies of metamorphism.

Towards the end of the Devonian and during the Carboniferous, various phases of the Wedgeport pluton intruded the area. Intrusion of the Goose Bay garnetiferous biotite granite was followed by the specialized Pinkneys Point biotite granite. At the contact with the Goldenville Formation the Pinkneys Point granite becomes strongly albitized and greisenized and is replaced by K-feldspar, albite, muscovite, topaz, fluorite, chlorite, anatase and more. Associated mineralization includes Sn-Cu-W-Zn-Mo-Ag-B-F. The Pinkneys Point granite is characterized by a definite U-Th systematics.

During Hercynian times all of the rocks in the area were deformed by northeast-southwest shear joints and faults, followed by NNW-SSE dextral shear joints. These joints formed the locus of further greisenization in the Pinkneys Point granite. Later, possibly Triassic, east-west sinistral shear joints cut the earlier structures. Olivine diabase dykes intruded the Wedgeport pluton along and across northeast-southwest faults.

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*Geological Society of America, Northeastern Section, Abstracts with Programs, 1981, v. 13, no.3, p. 140

PLUTONISM AND ASSOCIATED MINERALIZATION IN NOVA SCOTIA*

J. D. Keppie and A. K. Chatterjee

In Nova Scotia, plutonism occurred predominantly during the Late Hadrynian-Cambrian (630-500 Ma) and the Devono-Carboniferous (415-290 Ma). Minor plutonism falls inside these times. The Late Hadrynian-Cambrian plutonism is of mixed I- and S-types and is confined to the area north of the Minas Geofracture. It is inferred to have been produced above a northwesterly dipping subduction zone, the igneous rock association varying with the tectonic unit. Thus, in the volcanic arc (Cape Breton Island) and in the remnant volcanic arc (Cobequid Highlands), the association is gabbro-diorite-granodiorite-granite; whereas, in the back-arc basin (Antigonish Highlands), the association is mainly gabbro-diorite. Initial Sr ratios (0.701-0.706) are consistent with lower crust/mantle origin. The Cambrian plutonism is mainly granite and is spatially linked to major crustal faults. This suggests that they were produced during transtension and uplift following the cessation of subduction, by partial melting and lateral migration along zones of vertical displacement. Initial Sr ratios (0.699-0.708) are consistent with an origin from a granulite-facies lower crust. The "porphyry" type Cu-Mo mineralization at Coxheath and St. Anns, and various types of contact-related skarn deposits in Cape Breton, are probably related to the Hadrynian-Cambrian plutonism.

The Devono-Carboniferous plutonism, possibly continuous, appears to have occurred mainly in three phases; in the Early/Middle Devonian (415-385 Ma), near the Devono-Carboniferous boundary (370 Ma), and during the Late Carboniferous (340-290 Ma). The earliest phase has only been recorded in Cape Breton Island: Warren Brook-Black Brook-White Point, S-type, granite pluton (386 ± 1 Ma, initial Sr = 0.71) and Gillis Mountain, I-type, diorite-granite stock (407 ± 22 Ma, initial Sr = 0.7025). These plutons are spatially associated with major faults and temporally linked with the Acadian Orogeny. These observations and their initial Sr ratios suggest an origin by partial melting of the mantle and lower crust adjacent to deep faults. The plutonic complex at Gillis Mountain and Deep Cove hosting Cu + Mo ± Bi ± Ag ± Au mineralization in shear zones, in vein swarms and stockworks is characterized by marked hydrothermal alteration. Microprobe studies of alteration minerals indicate that hydrothermal pyroxene, amphibole and biotite are magnesium-rich and titanium-poor when compared to magmatic silicates from the same, or similiar, rock type. The alteration-mineralization zonation is characterized by increasing Mg/Mg + Fe ratios of biotite, amphibole and proxene toward the mineralized veins. In comparison to the barren diorites and granites, the mineralized plutonic complexes in northern Nova Scotia are specialized in B, F, S, Co, Ni, Cr, Cu, Zn and Sn.

The ca. 370 Ma phase produced the South Mountain batholith and neighbouring plutons, with a few small bodies adjacent to the Minas

* 83rd Annual General Meeting 1981, CIM Bulletin, v. 74, no. 827, p.92-94

Geofracture. Rock types include S-type granodiorite, granite and minor late phases. The origin of the South Mountain batholith is somewhat enigmatic because it formed after the Acadian Orogeny and before the onset of the Hercynian Orogeny, and it does not appear to be spatially associated with any major crustal faults. It concides with the rapid, 1500 km northeastward movement of the southeastern Maritimes microplate from a position off the southern Appalachians. It is postulated that this movement took place on a horizontal decollement zone near the base of the crust which induced partial melting and aggregation of the magma. Initial Sr ratios (0.7075-0.71) are consistent with magma generation from the lower crust progressively contaminated by supracrustal metasedimentary rocks. The principal Sn, W and U mineralization in the granitoid rocks of the South Mountain batholith is related to the highly fractionated leuco-monzogranite with superimposed autometasomatic alteration. Various types of mineralization are restricted to the greisenized granites, which show marked enrichement in F, Li, Be, Rb, U, Sn and CO_2. In these rocks, the rock-forming minerals are of several generations and are in complex, sometimes contradicting, relation. The Mg/Mg + Fe ratios between co-existing micas and lack of compositional equilibrium between albite and K-feldspar have been suggested as evidence against magmatic co-crystallization.

The Late Carboniferous phase produced a diorite-granodiorite-granite association spatially associated with the Minas Geofracture and a few other major faults. This phase is temporally associated with the Hercynian deformation which produced major dextral movement (at least 165 km) and some vertical displacement on the Minas Geofracture, thereby inducing partial melting and lateral migration of magma. Initial Sr ratios (0.705-0.71) are consistent with an origin from the lower crust. The metallogenic implications of this Late Carboniferous phase are, at present, poorly understood. However, the Sn-W-Mo mineralization associated with the Wedgeport pluton may be of Carboniferous age.

SN, W, MO, AND U MINERALIZATION IN THE APPALACHIAN-HERCYNIAN FOLD BELT: A REGIONAL METALLOGENIC COMPARISON*

A. K. Chatterjee

Important Sn, W, Mo, and U mineralization in the Meguma Zone is spatially and probably genetically related to the emplacement of the granitoid rocks of Devono-Carboniferous age. The mineralization is enclosed either in the granitoid rocks (intrabatholithic) or in the metamorphic rocks of the aureoles (peribatholithic). Similar geological situations are also found in the Hercynian province of western Europe. For regional comparisons examples are selected from the Iberian Meseta (Alto-Altenterjo, Fe, Morille and Galicia), the Armorican Massif (Mortagne), the Massif Central (Margnac, Peny, Hyverneresse and Montredon-Labessonnie) and the Bohemian Massif (Pechtelsgrun, Freiberg, Cinovec, Pribram and Jachymov).

The intrabatholithic mineralization varies in form from a linear type with vein infillings or sheet-like bodies to a columnar type in the greisenized granite. The enclosing granites generally have a leucocratic mineral composition and a special association of accessory minerals, among which cassiterite, helvite, uraninite, topaz, tourmaline, granet, dark micas of siderophyllite-protolithionite composition and fluorite are important. Geochemically the granites are characterized by higher SiO_2 and K_2O contents, lower contents of TiO_2, Fe_2O_3, MgO, and CaO, and a strong increase in Rb, Sn, U , Li, Be, and F when compared with normal granites. Often the columnar type of mineralization is represented by the presence of vacular rocks (episynites) of various compositions. The enclosing granites are also characterized by late-magmatic auto-metasomatic and post-magmatic metasomatism leading to muscovitization, albitization and greisenization.

The peribatholithic mineralization occurs as impregnations, as replacement veins and as net-vein stringers in shear zones in the pelitic rocks within the metamorphic aureole of the specialized/fertile granites. Characteristically, the Sn-W-Mo mineralization occurs in oxide-silicate-sulphide association (e.g. cassiterite-wolframite-hematite-malayite $\pm$ sulphides of Cu, Zn, and Ag), whereas the uranium mineralization is essentially in the form of silicate-phosphate-sulphide-association (e.g. coffinite-autunite-saleeite-phosphuranylite-pyrite-chalcocite). Geochemically the enclosing pelitic rocks are characterized by increased levels of Cu, Zn, Sn, U, Li, and F when compared with the average Paleozoic shale.

Based on geological, mineralogical, geochemical and regional metallogenesis, it is concluded that the granitoid rocks in the Appalachian-Hercynian tectonic province have acted as metallotects, and many features may be used in the search for both surface and hidden deposits of endogenous type.

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*Atlantic Geoscience Society, Symposium on Mineral and Energy Resources of the Atlantic Provinces, Fredericton, New Brunswick, January 1981.

THE DISTRIBUTION OF GOLD IN ROCKS AND MINERALS OF THE MEGUMA GROUP OF NOVA SCOTIA*

R. R. Brooks[1], A. K. Chatterjee, P. K. Smith, D. E. Ryan[1] and H. F. Zhang[1]

ABSTRACT

Rocks and constituent minerals of the Meguma Group from southeastern Nova Scotia were analyzed for gold. By far the highest levels (4311 ng/g = ppb) were found in arsenopyrites with lesser amounts in pyrites (76 ppb), quartz (1.9 ppb), whole rocks (1.0 ppb) and other minerals (<0.3 ppb). Good agreement in gold concentrations for arsenopyrites and pyrites for separate samples of rocks collected from identical collection localities, indicated that the occurrence of gold with sulphide minerals was probably as a result of solid solution rather than random aggregation of grains around the crystals of sulphide minerals. Relatively low gold values in rocks and minerals collected on or near the contact metamorphic aureoles of the Sherbrooke granitic pluton lend weight to the theory that gold mineralization is derived from lateral secretion from adjacent greywackes rather than being derived from granitic intrusions. Highest gold levels were found in rocks and minerals from an old gold mining region in southeastern Nova Scotia.

*Chemical Geology, in press

[1]Trace Analysis Research Centre, Department of Chemistry, Dalhousie University, Halifax, Nova Scotia

LITHOGEOCHEMICAL INDICATORS OF URANIUM AND TIN MINERALIZATION IN THE SOUTH MOUNTAIN BATHOLITH, NOVA SCOTIA*

A. K. Chatterjee and G. K. Muecke[1]

The South Mountain Batholith (SMB) of Nova Scotia is a post-tectonic peraluminous granodiorite-granite complex which intruded Cambro-Ordovician to Lower Devonian metasediments and volcanics. Stratigraphic relations and radiometric dating constrain the time interval between complete crystallization of the batholith (372-361 Ma) and surface exposure through erosion to a few million years.

The main mass of the batholith consists of biotite granodiorite into which are intruded a number of smaller, discrete bodies of biotite-muscovite monzogranite (including porphyries) and dykes and irregular bodies of aplite and pegmatite. Major and trace element and isotopic studies suggest that all these bodies form part of a *cogenetic suite*. Although fractional crystallization played a major part during the early differentiation process, it cannot adequately explain the evolution of the late stage rocks. The generation of a fluorine-rich fluid phase is thought to have played a major role in determining geochemical trends during the terminal phases of crystallization of the batholith. A *para-intrusive suite*, consisting of biotite leucogranite, argillized and sericitized granites, albitized granites and albitites as well as various types of greisen, appears to be the product of the interaction of the fluid with residual magma and/or crystalline rocks. The principal Sn-W, Sn-Be, Sn-W-U, W-Mo-U, and U-P-F mineralization in the SMB is spatially and genetically associated with the monzogranite-leucocratic monzogranite bodies, and in particular with para-intrusive rocks found within these complexes. The rapid unroofing of the batholith following its emplacement produced dilatancy and shear fractures which acted as channelways to mineralizing fluids and resulted in mineralized zones in (e.g. Gaspereau Lake or near e.g. Millet Brook) the most differentiated portions of the batholith.

In the co-genetic suite mean concentrations show an increase in U and decrease in Th abundance from the least differentiated granodiorites to the highly differentiated leucocratic monzogranites. The decrease in the Th/U ratio with differentiation (3.0 - 0.5) is accompanied by progressive enrichment in F, Be, Li, Rb, Cs, Ta, Sn and depletion in Sr, Ba, REEs, Sc, Zr, Hf. In the para-intrusive suite elemental correlations often break down and particular elements, for example U versus Th, can show extreme enrichments or depletions. The negative correlation between Th and U as well as Th depletion is not shared by all the plutons. The Davis Lake and Plymouth plutons show a positive correlation and elevated Th abundances in the para-intrusive suites; both bodies are associated with substantial Sn-W mineralization.

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*Atlantic Geoscience Society, Symposium on Mineral and Energy Resources of the Atlantic Provinces, Fredericton, New Brunswick, January 1981.

[1]Department of Geology, Dalhousie University, Halifax, Nova Scotia.

Airborn gamma-ray spectrometric maps indicate the presence of a number of other high radioactivity, high thorium bodies in the SMB which have not yet been studied, but should be of interest in mineral exploration. Other lithogeochemical indicators of mineralization include elevated alkali element (Li, Rb, Cs) and fluorine abundances and rare earth enrichment in fluorites.

THE FISSET BROOK FORMATION AT LOWLAND COVE, INVERNESS COUNTY, NOVA SCOTIA*

P. K. Smith and A. S. Macdonald

ABSTRACT

At Lowland Cove, northern Cape Breton Island, the Fisset Brook Formation consists of a sequence of massive porphyritic rhyolite flows overlain by conglomerate interbedded with sandstone and siltstone, followed by basaltic and andesitic tuffs and flows representing approximately 400 m of stratigraphic thickness. This sequence lies unconformably on ?Devonian and earlier granitoid basement rocks, and is in turn unconformably overlain by siltstones and conglomerates of the Carboniferous Horton Group. Spores recovered from the sedimentary rocks in the Fisset Brook Formation indicate a Late Devonian age. The geochemistry of the volcanic section documents bimodal and mildly alkalic rocks with some tholeiitic characteristics. The Fisset Brook Formation at Lowland Cove has been gently folded about a northward plunging, upright syncline, and cut by faults. Minor pyrite/chalcopyrite mineralization associated with calcite veins occurs in the basaltic tuff. Traces of malachite occur in fault zones cutting the rhyolites and conglomerates along the shore.

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* Nova Scotia Department of Mines and Energy, Paper 81-1

MEGUMA GROUP STUDIES*

SUMMARY

P. K. Smith

The Cambro-Ordovician Meguma Group consists of the Goldenville Formation, overlain by the Halifax Formation. Repetitious metawacke beds with thin slate partings dominate the Goldenville Formation. A 1158.5 m measured section at Indian Harbour supports the rhythmic nature of sedimentation found elsewhere in southern Nova Scotia. Paleocurrent data suggest a western source area. The presence of rounded and spherical grains suggests derivation from a mature, probably very old, quartz sandstone, volcanic and granitoid source. Although turbidity current deposition adequately explains the observed sequence of some beds, it does not provide a realistic depositional mechanism for many of the beds.

During the Acadian Orogeny, the Meguma Group was deformed into east-west trending, opened to closed, upright to slightly overturned cylindrical folds with axial planar slaty cleavage. Locally, where these folds are conical in shape, there is a strong correlation with gold deposits.

The Meguma Group was subsequently regionally metamorphosed to greenschist and amphibolite facies. Metamorphic mineral zonation is chlorite -> biotite -> biotite/amphibole -> garnet -> andalusite/staurolite. Andalusite occurs in the graphitic slates of the Halifax Formation within the garnet and staurolite zones. Cordierite, although not encountered, has been reported from the Meguma Group both east and west of this study area. Pressure-temperature relations, established by porphyroblastic mineral assemblages for the peak of metamorphism suggest about 5.5 kbars and 550-600°C. Augen gneiss, in part cataclastic, is developed in the higher metamorphic zones adjacent to the West River St. Marys Fault.

The Sherbrooke pluton of granitic composition crosscuts the regional fold trends. Geochemistry and lithology suggest this pluton is composed of at least two separate phases followed by the intrusion of aplite and pegmatite dykes. Chemical analyses suggest that the mineralizing potential of the late phases may be high, especially with respect to tin, although no mineralization has been observed in thin section.

Contact metamorphism associated with the Sherbrooke pluton has not been observed near any of the exposed contacts suggesting either relatively cool granite temperatures, or wall rock temperatures near the peak metamorphic conditions. Fine grained quartz-granet bearing rocks south of the Waternish Syncline are believed to be the result of contact metamorphism above a buried pluton.

A paleoplacer gold model is postulated with later remobilization during diagenesis, deformation and metamorphism. The gold is inferred to have been carried in silica-rich solutions derived from the disintegration of detrital quartz and the breakdown of organic matter. Under favorable conditions, high concentrations of gold have developed as

*Nova Scotia Department of Mines and Energy, Paper in preparation.

saddle reef deposits during deformation and metamorphism of the Meguma Group. Several other origins for the Meguma gold are also possible, for example gold derived from lower crustal levels, or gold derived from associated plutonic rocks.

RED RIVER ANORTHOSITE COMPLEX, NORTHERN CAPE BRETON ISLAND*

P. K. Smith and A. S. Macdonald

The anorthositic rocks of Cape Breton Island, Nova Scotia, were first mapped by Neale (1963) and described by Jenness (1966). Currie (1975) referred to the anorthosites, and associated gneissic and granitoid rocks as the Grande Anse Complex.

The largest of the lenticular anorthosite bodies was named the Red River anorthosite body by Jenness (1966) for the exposures on the Red River and its tributaries. The name, Red River Anorthosite Complex is suggested in this study to better express the complexity and lithologic variation of the area.

The area is divided into three distinct zones by two prominent mylonite units. The east and west zones are underlain by para- and ortho-gneiss, pelitic and psammitic schists, numerous granitic intrusive rocks, minor marbles and calc-silcates. The central zone is dominated by para- and ortho-gneiss, foliated granite sheets, monzodiorite-gabbro rocks and the anorthositic suite as well as younger granitoid intrusions. Marble and calc-silicates also occur within the mylonite zones. Crosscutting aplite and diabase dykes have only been observed in the central zone.

The Red River Anorthosite Complex, consisting of anorthosite, gabbroic anorthosite and anorthosite gabbro, constitutes the oldest intrusive body in the area. The dominant northeast-southwest structural trends in the anorthosite complex conform to the D_1 structural trends of the surrounding country rocks. Textures in the anorthosite complex are granoblastic to strongly cataclastic and the internal structure varies from gneissic or schistose to weakly foliated, or even massive. Local primary layering occurs where mafic minerals are more abundant and deformation slight.

Major oxide, trace and rare earth element analyses suggest that the Red River Anorthosite Complex is derived from a parent magma source similar to that of several large massif-type anorthosites in the Grenville and Nain Provinces of the Canadian Shield. However, the lenticular shape of the complex, cumulate texture and lack of associated charnokitic rocks might suggest a layered-type intrusion.

The occurrence of a sliver of pyroxene granulite facies and the occurrence of lenticular anorthosite bodies suggest that rocks of the central zone may be tectonically emplaced basement material. Dating of these rocks will be required for further confirmation.

Intrusive into the anorthosite complex is a medium grained monzodiorite-gabbro intrusion, locally foliated and exhibiting cumulate textures. Pyroxene relics are sparcely distributed throughout.

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*Nova Scotia Department of Mines and Energy, Paper, in preparation.

Younger unfoliated intrusive rocks in the area include syenite, granite, and megacrystic granite, and occur throughout the area. Rhyolite porphyry and diabase dykes are the last intrusive events cross-cutting anorthosite and mylonite zones.

Porphyroblastic minerals, best preserved in the gneisses and schists of the eastern zone, where retrograde effects are less severe, suggest peak metamorphic conditions of about 650°C and 6-7 kbars. Diagnostic porphyroblastic minerals in this zone include kyanite, ortho- and clino-amphibole, garnet and the micas. Metamorphic conditions appear similar to those reported farther north (Macdonald and Smith, 1980) which are transitional between Abukuma and Barrovian facies series (Winkler, 1967).

Porphyroblastic minerals from the central zone include relic pyroxene, amphiboles, and micas. Clino- and ortho-pyroxene, which occur in a small sliver of pyroxene-granulite gneiss on the Red River suggest higher temperature metamorphic conditions for the central zone.

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RADIOMETRIC AGES FROM THE AVALON ZONE OF NORTHERN NOVA SCOTIA AND CAPE BRETON ISLAND*

H. V. Donohoe, Jr. and S. M. Barr[1]

ABSTRACT

Radiometric ages from northern Nova Scotia and Cape Breton Island (part of the Avalon Zone) fall into two groups: 1) Hadrynian through early Ordovician with most ages in the Cambrian, and 2) Silurian through Carboniferous with most ages in the Devonian. These ages are primarily from plutonic rocks, with some from felsic volcanic and metamorphic rocks. Rock units of possible pre-Hadrynian age have not been successfully dated. Ages obtained from minerals in gneisses in the Cobequid Highlands and northern Nova Scotia and Cape Breton Highlands are Hadrynian, Cambrian or Devonian and have probably been up-dated by later thermal events. A major syn- to post-tectonic plutonic event in the Avalon Zone of northern Nova Scotia and Cape Breton Island occurred in Late Hadrynian to Late Cambrian time and was related to the Cadomian Orogeny. These plutons range in composition from diorite to granite (classified as I-type). The dates reflect the post-tectonic plutonism. The second plutonic event ranges in age from Devonian to Carboniferous and is related to the Acadian and Hercynian Orogenies. These plutons appear to be predominantly I-type, although some S-type granites occur in the northern Cape Breton Highlands. The youngest dated plutons occur along the southern edge of the Avalon Zone adjacent to Cobequid Fault Zone and in the northern Cape Breton Highlands adjacent to the Aspy Fault.

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*Abstract from paper presented at the Geological Society of America, NE Section meeting, Bangor, Maine, April, 1981
Reprinted from Geological Society of America, Abstracts with Programs 1981, v.13, no.3, p. 129.

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METASOMATIC-HYDROTHERMAL DEPOSITS OF THE NEW ROSS-MAHONE BAY AREA, NOVA SCOTIA*

G. A. O'Reilly, E. J. Farley[1] and M. H. Charest[2]

ABSTRACT

Many reported occurrences of Mo, Sn, W, Cu, F, Mn, Li and U are associated with the South Mountain batholith in the New Ross-Mahone Bay area of southwestern Nova Scotia. The mineral occurrences of metasomatic-hydrothermal affinity associated with the batholith were mapped and sampled in light of metallogenic theories postulated for the origin of similar deposits in Europe and Asia.

In southwestern Nova Scotia it was found that mineral occurrences can be classified into the following three main types: (1) those that are directly hosted by magmatic late stage differentiates of the South Mountain batholith such as pegmatite, leucomonzogranite and leucogranite, (2) those that are of metasomatic origin or associated with apogranite formation at the peripheral and apical parts of the batholith. The metasomatism may be due, at least in part, to specialized granite plutons enriched in Sn, F, Li, Rb, U, Be and K, and (3) those that are of hydrothermal origin. These include occurrences related directly to the hydrothermal stage in the differentiation of the South Mountain batholith and those likely related to a mixture of hydrothermal fluids with meteoric or connate waters.

The geology and mineral deposits associated with the South Mountain batholith and the Meguma block into which it has intruded compare favourably with the geology of Paleozoic fold belts of Europe.

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*Nova Scotia Department of Mines and Energy, Paper, in preparation.

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MAJOR TRANSGRESSIVE-REGRESSIVE CYCLES IN MIDDLE TO LATE VISEAN ROCKS OF NOVA SCOTIA*

P. S. Giles

ABSTRACT

The Windsor Group of Middle to Late Visean age comprises as many as seven formations, the equivalents of which can be recognized throughout Nova Scotia. These can be assigned to five major transgressive-regressive cycles, the earliest of which is characterized by the ascending sequence carbonate-anhydrite-halite-siltstone. Adjacent to paleo-basin margins, terrigenous rocks complicate this sequence. Cycles 2 to 5 are regionally more variable than is the first major cycle, but are typified by numerous laterally extensive marine carbonate members, associated with rocks typical of arid tidal-flat and continental sedimentary environments. Cycle 5 includes rocks assigned to the lowermost part of Canso Group (Visean-Namurian).

The lower boundaries of the cycles, defined using lithologic criteria, coincide reasonably with biostratigraphic boundaries determined by independent studies of macrofauna, calcareous Foraminifera, conodonts and miospores. This coincidence suggests that the cycles are bounded by approximate time planes. Similar major transgressive-regressive cycles have been recognized in the Dinantian of Britain, where they correspond approximately with recently defined stages. Biostratigraphic correlation of the Windsor cycles suggests that Cycle 1 is equivalent in age to the Arundian and possibly the Holkerian stage. Cycle 2 equates in age with part or all of the Holkerian, and possibly extends into the Asbian. Cycles 3, 4, and 5 appear to be within the British Brigantian stage.

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*Nova Scotia Department of Mines and Energy, Paper 81-2

TILL MAPPING AND GEOCHEMISTRY: STATUS REPORT

R. R. Stea

To date, four colour maps at a scale of 1:100 000 depicting the distribution, stratigraphy and geochemistry of Nova Scotian tills, have been published. These include maps of the Eastern Shore and Central Nova Scotia regions (Fig. 1). Map 6 covering portions of the three adjoining Counties of Shelburne, Queens and Lunenburg is in press. Maps 5, 7, and 8 encompassing the rest of southern Nova Scotia are in preparation. Maps 7 and 8, covering all of Yarmouth County, Digby County and portions of Shelburne and Annapolis Counties will be co-authored with Dr. D. R. Grant of the Geological Survey of Canada, who has mapped extensively in that area.

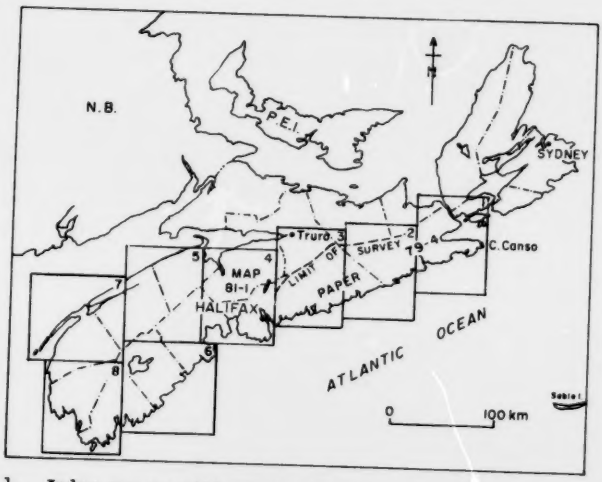

Figure 1. Index map to till geochemistry maps produced by Nova Scotia Department of Mines and Energy.

The maps include information on the properties, distribution and stratigraphy of Pleistocene sediments as well as analyses of Cu, Pb, Zn, Co, Ni, Fe, Mn, Ca, Mg, Cd, Ag, Mo, U, As, Sn and W. Ice flow direction indicators also are mapped.

This survey provides useful background data to geologists, engineers and laymen working with surficial materials in these areas.

PLEISTOCENE STRATIGRAPHY OF CENTRAL NOVA SCOTIA

R. R. Stea

INTRODUCTION

Substantial drift thicknesses are a characteristic of the rolling lowland terrain in central Nova Scotia (Hants and Kings Counties). During the mapping of this region, it became obvious to the author that this drift is made up of a complicated sequence of till units, recessional sediments and occasionally, buried organic beds.

Till mapping is an integral part of the regional till geochemistry program conducted by the Nova Scotia Department of Mines and Energy. In the central Nova Scotia area a map has been produced showing the surface distribution, stratigraphy, and geochemistry of the major till units in the region (Stea and Fowler, 1981). Exploration companies utilizing three dimensional overburden exploration techniques need to know the Pleistocene stratigraphy, especially the relation of anomalous till units to ice flow phases (Averill, 1978). This report summarizes the present state of knowledge on the stratigraphy and provenance of tills in central Nova Scotia, and relates each till to directions of the ice flow that emplaced it.

MAJOR PLEISTOCENE UNITS

The major Pleistocene units in the area are discussed below from the oldest to the youngest.

Fossiliferous Karst Sediments

The oldest lithostratigraphic unit in the region may be the organics found in sinkholes at the National Gypsum East Milford quarry (Take *in* Prest, 1970). The sinkhole depressions were described as being truncated and overlain by a greyish till, which was overlain by another organic bed. At Noel, Hants County (Figs. 1, 2) Shell Minerals geologists described two organic beds, both overlain and underlain by tills. A correlation of the basal organic bed at Noel with the karst sediments at East Milford is uncertain, because of the many processes of stratigraphic disruption inherent in karst regions.

Miller Creek Till

The Miller Creek till is best exposed at the Fundy Gypsum Miller Creek quarry (Fig. 1). This till underlies peat beds containing wood dated at >52 000 years B.P. (GSC-2694). A zone of leaching was found at the peat-till interface. The bottom of this till has not been seen at any exposure. The Miller Creek till is reddish-brown (10R3/4), noncalcareous and mud rich (average 70.6% silt and clay) (Table 1). It contains many erratics from the Cobequid Highlands. Due to poor exposure, the direction of ice flow that emplaced this till can only be suggested as coming from the north.

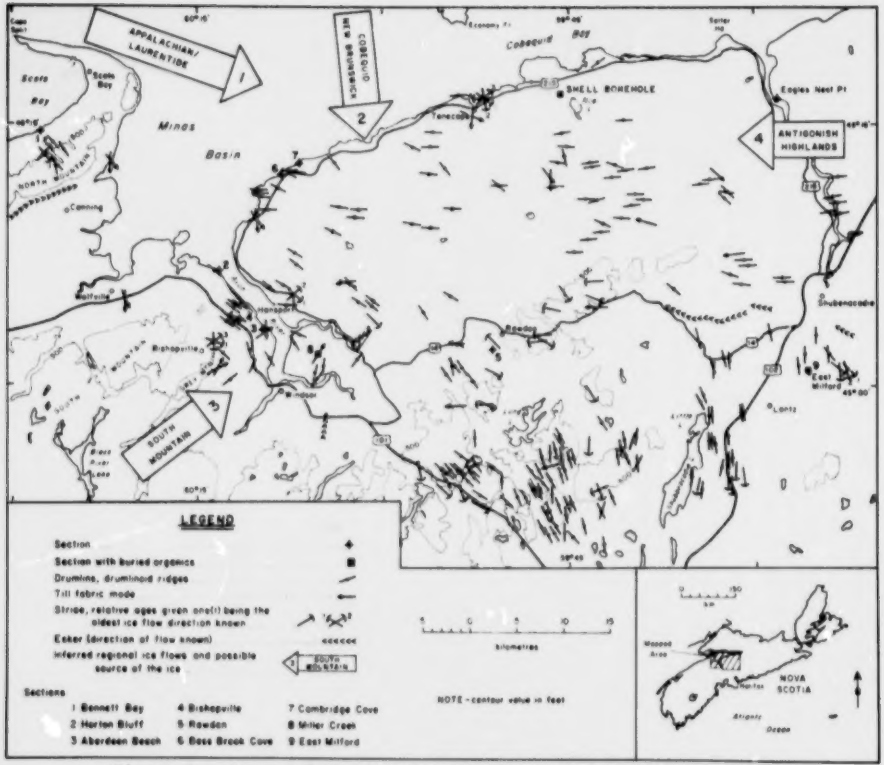

Figure 1. A map of the ice flow features of central Nova Scotia showing the inferred Wisconsinan ice centres.

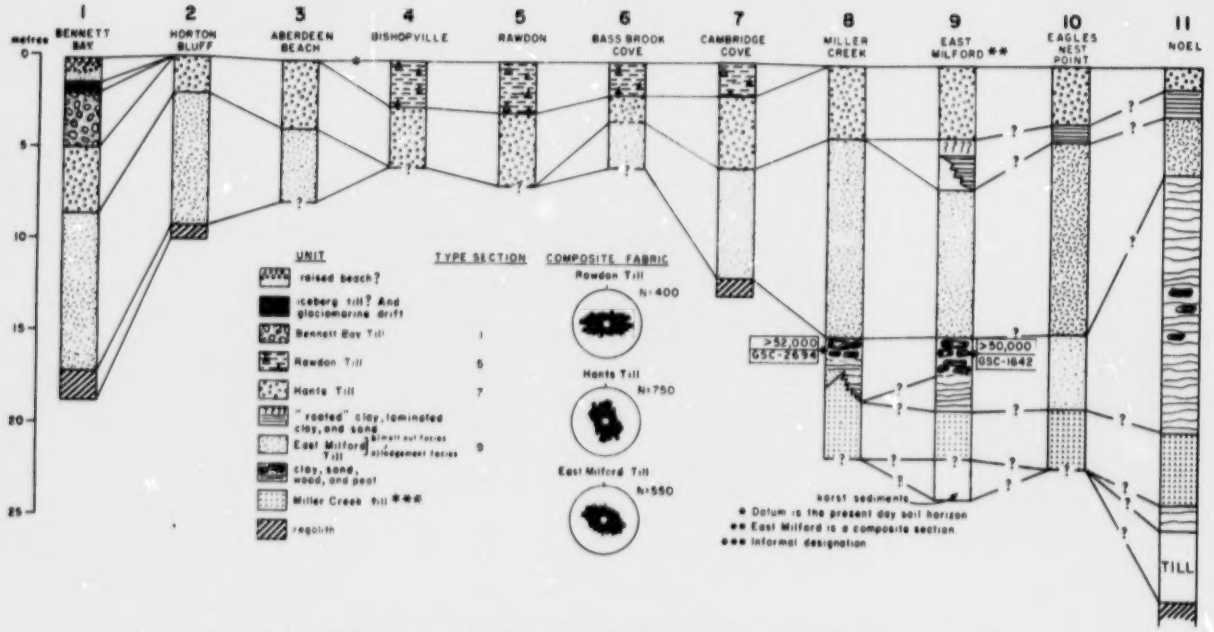

Figure 2. Regional correlation of Pleistocene units in central Nova Scotia.

Table 1. Summary statistics for the major till units in central Nova Scotia.

	Gravel%	Sand%	Mud%	Basaltic%	Granitic%	Cu ppm	Pb ppm	Zn ppm	Fe%	Mn ppm	Ca ppm	Mg ppm
Bennett Bay till	26.0-48.5	41.0-52.6	10.5-28.4	91.7-97.8	0-.5	142-260	17-68	55-90	4-6.7	778-2060	6920-11000	12000-21000
N=7	37.5	46.8	15.5	94.4	0.19	175	39.1	73.1	5.2	1175.1	8640.0	16560.0
Rawdon till	7.1-31.3	2.28-42.0	30.8-66.5	0-2.0	0-1.2	27-70	16-23	112-160	2.6-5.8	440-1000	280-7540	4900-9520
N=7	15.6	35.0	49.4	0.60	0.70	48.9	20.6	134.9	4.3	731.4	1991.4	7608.6
Nanta till	5.6-48.1	25.7-60.9	17.5-64.1	0-97.5	0-9.4	31-140	13-24	89-162	2.2-6.3	400-1240	1700-14800	6020-20400
N=31	18.4	41.6	40.0	35.0	1.7	57.4	20.2	116.8	4.4	647.9	5632.9	11387.1
East Milford till	1.0-33.6	24.8-59.2	32.4-73.3	0-63.6	0-20.4	18-72	13-30	92-172	3.4-5.2	300-1400	1580-15600	6100-13420
N=36	11.8	36.5	52.0	12.4	2.6	35.9	21.4	125.2	3.9	657.5	6429.7	9843.4
Miller Creek till	1.5-5.0	19.2-33.2	65.3-75.8	1.4-2.9	9.8-27.6							
N=2	3.3	26.2	70.6	2.6	18.7							
	Range											
	Mean											

Buried Organics

At the East Milford and Miller Creek gypsum quarries 1-3 m of wood bearing peat and clay has been discovered underlying 20 m or more of drift and overlying the Miller Creek till. Radio carbon dating of these beds indicates an age >50 000 years B.P. Palynological studies on the organic beds at Miller Creek (Stea, unpublished M.Sc. thesis) and East Milford (Mott, unpublished Palynological Report 81-4) indicate cooler climatic conditions prevailing through most of this interval. These beds have been assigned to the St. Pierre Interstade by Grant (1975).

East Milford Till

The East Milford Till represents the major lithostratigraphic unit in the area, attaining thicknesses of 20 m. It is named after its type section at East Milford, Halifax County, Nova Scotia. It generally forms the drumlins in the region representing the surface topographic features. It is greyish-red (10R4/2), calcareous, compact and massive. A crude layering is sometimes present, with sand inclusions, lenses and boulder horizons. It averages 11.8% gravel, 36.5% sand, and 52.0% mud. Basaltic erratics derived from the North Mountain average 12.4% in this Till. Ca is enriched in the clay fraction (<2 ø) of this till, averaging 6429 ppm (Table 1). The East Milford Till can be divided into two genetic facies: a basal lodgement facies with a higher percentage of locally derived clasts and a stronger fabric; and a melt-out facies with a higher percentage of erratics. Till fabric (Fig. 2), and underlying bedrock striations imply that this Till was emplaced by southeasterly flowing ice.

Clay and Sand

At Eagles Nest Point, East Milford and Noel, 1-4 m of clay, laminated clay and/or sand is found above the East Milford Till 3-4 m below the surface (Figs. 1, 2). These beds suggest a minor recessional period after the deposition of the East Milford Till.

Hants Till

The Hants Till (also referred to as the Lawrencetown Till) represents the surface till sheet, 2-4 m thick, over much of central (Hants County) Nova Scotia. It is generally reddish-brown (10R4/6), noncalcareous, fissile, moderately compact and weathered. It is enriched in gravel (average 18.4%) compared to the East Milford Till and also enriched in basaltic erratics (average 35%). The Hants Till has greater values of Cu (average 57.4 ppm) and Fe (average 4.4 ppm) than the East Milford Till. The Cu enrichment is probably due to the high percentage of cupriferous North Mountain basalt. Fe enrichment in the Hants Till may reflect its relatively weathered state. The Hants Till is also characterized by usually having two distinct fabric modes striking 140°-160° and 180°-210° (Fig. 2).

Fabric and pebble lithology studies suggest that the ice that formed this till sheet flowed south in an initial stage, and then

reversed flowing in a northeasterly direction. Striation sets in the region trend south and northeast (Fig. 1). Hickox (1962) described blocks of South Mountain granite within the Hants Till at the base of the North Mountain. The author has noted slate clasts, probably derived from outcrop to the southwest, in the Hants Till along the Avon River. The author believes that this till is largely a product of the reworking of the East Milford Till during a period of changing ice divides.

Bennett Bay Till

The northeasterly flow that emanated from a South Mountain ice cap produced a bouldery, basalt-rich till at Bennett Bay, near Scots Bay (Figs. 1, 2) by overriding the North Mountain. This till overlies reddish-brown clay tills (Hants and East Milford Tills) derived in part from sediments in the Bay of Fundy.

Rawdon Till

The Rawdon Till is named after the Village of Rawdon, Nova Scotia, near where it is best exposed (Fig. 1). It is a clay rich, grey-black lodgement till that contains a high percentage of slate clasts, the underlying bedrock lithology. The low Ca values of this till (average 1991 ppm) are evidence of the lack of northern components (Carboniferous and Triassic bedrock). It overlies a reddish brown clay till (Hants Till).

Fabric in this till is oriented in the same direction as westerly trending striation sets in the region. This infers that the Rawdon Till was emplaced by westerly flowing ice. This till is exposed in patches along the Minas Basin shore and on the Rawdon Hills. This westerly flow appears to be the last active phase of ice movement in this region.

CHRONOLOGY

The time frame for the units described in this text is uncertain because the age of the buried organics at East Milford and Miller Creek, overlying the Miller Creek till can only be stated as greater than 50 000 years B.P. If the correlation of these organic beds with the St. Pierre Interstade is valid (Grant, 1975), then the finite date of 75 000 years B.P. obtained by Stuiver et al. (1978) may represent the true age of these deposits. The Miller Creek till is tentatively assigned to the Early Wisconsinan, using the 'long Chronology' of Dreimanis (1975). The fossiliferous karst sediments at East Milford and lower organic beds at Noel may have been deposited during the Sangamon Interglacial.

The East Milford Till was probably deposited during the Early-Middle Wisconsinan (65 000-40 000 years B.P.). The minor recessional interval above the East Milford Till may be Mid-Wisconsinan in age, although the beds have not, as yet, been dated directly. The overlying tills (Hants, Bennett Bay, Rawdon) represent pulses in the Late Wisconsinan (30 000-12 000 years B.P.) when ice flowing across the Bay of Fundy was segregated and reactivated from local ice centres. A pictorial summary of the suggested chronostratigraphic sequence is presented in Figure 3.

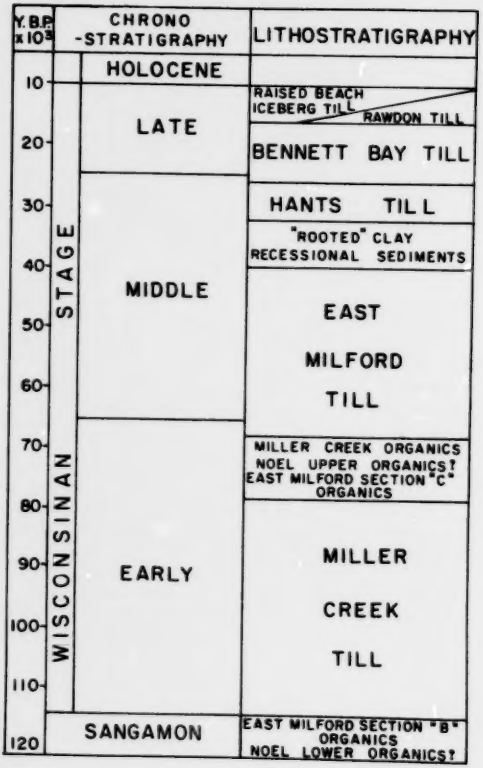

Figure 3. Tenative chronostratigraphic chart for the lithostratigraphic units described in the text.

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GEOLOGY AND GEOCHEMISTRY OF THE WESTFIELD W-Mo-Sn-Ag-Au PROSPECT, QUEENS COUNTY*

G. A. O'Reilly

At Westfield, W-Mo-Sn-Ag-Au mineralization is localized in the contact zone of the South Mountain batholith and slates of the Cambro-Ordovician Meguma Group (Fig. 1). Mineralization occurs in: (1) albitized and greisenized granitic rocks, (2) greisenized country rocks, (3) quartz vein stockworks and large (>4 m thick) quartz fissure veins and lenses found both traversing the granite-country rock contact and in the slates up to approximately 1 km from the batholith.

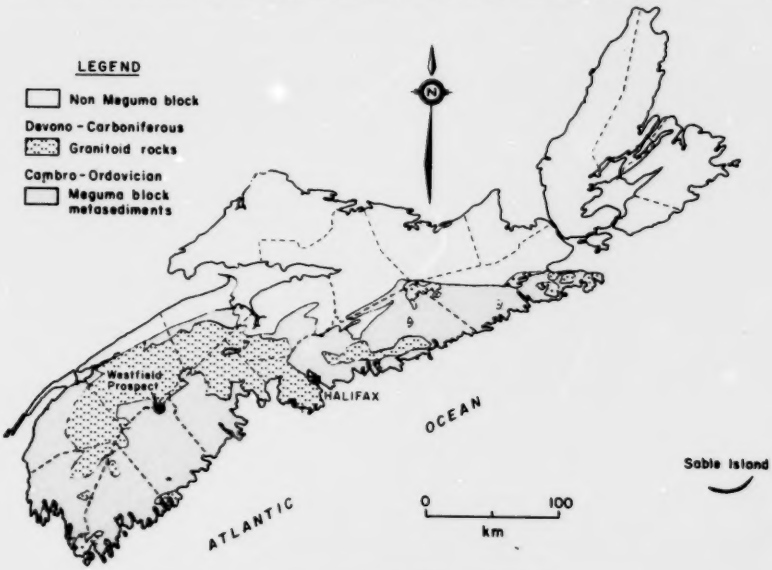

Figure 1. Location map of the Westfield prospect.

Within the granitic rocks scheelite, cassiterite, molybdenite, pyrargyrite, arsenopyrite and pyrite occur as disseminations in an albitized and greisenized cupola and in quartz vein stockworks. The large quartz fissure veins contain, scheelite, cassiterite, molybdenite, pyrargyrite, Cu, Pb, Zn sulphides, arsenopyrite, pyrite and marcasite. In the past gold has been reported to occur as free gold and as disseminations in sulphides, especially arsenopyrite, from the 8-23 m thick Jumbo fissure vein. Quartz-muscovite-tourmaline greisens occur both at the cupola-country rock contact and also as a marginal phase or contact zone of the slate hosted fissure veins. The greisens contain disseminations of cassiterite, scheelite and polymetallic sulphides.

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* Nova Scotia Department of Mines and Energy, Paper, in preparation

Geochemically the Westfield suite of altered granitic rocks show enrichment or specialization in Sn, W, B, Cu and Pb when compared with the unmineralized phases of the South Mountain batholith. The above specialization of the metallogenetic elements in the granitoid rocks of the Westfield area compares favourably with other deposits found in Nova Scotia and also in the tin belts of Western Europe.

It is suggested that a study of the signature of this specialization may be used successfully in exploration for deposits of the Westfield and similar types.

A SUMMARY ON THE PETROMETALLOGENESIS OF THE URANIUM MINERALIZATION AT MILLET BROOK, SOUTH MOUNTAIN BATHOLITH, NOVA SCOTIA*

A. K. Chatterjee, J. Robertson[1], and D. Pollock[1]

The Millet Brook uranium prospect is located in NTS 21A/16, approximately 50 km west-northwest of Halifax. The area of drilling is to the west of Falls Lake, 18 km southwest of the town of Windsor (Fig. 1). The mineralization at Millet Brook was discovered in 1977, shortly after Aquitaine's followup work by ground prospecting in areas of distinct airborne radiometric anomalies. In 1978, detailed prospecting and trenching during the summer led to the staking of 1737 claims in the surrounding area, and a diamond-drilling program of 8 holes on the zones now called C1 and C2.

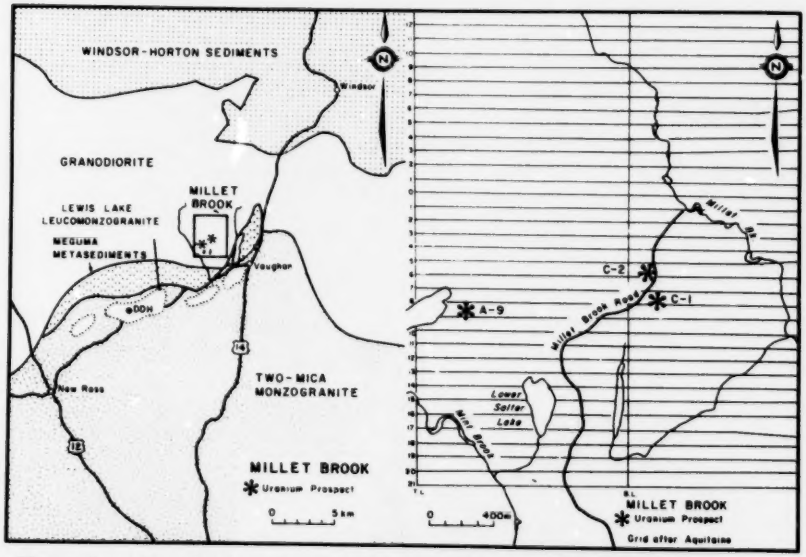

Figure 1. Map showing the generalized geology of the Millet Brook area. The configuration of the Lake Lewis and other leucomonzogranite plutons is based on the published airborne radiometrics. The location of the diamond-drill hole within the Lewis Lake pluton is approximate and the stars designated as C1, C2, and A9 are the locations of the separate mineralized zones in the biotite granodiorite of the South Mountain batholith.

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*Geological Association of Canada Field Trip: Appalachian Minerals, Fredericton, New Brunswick, 1981.
A detailed discussion on the data presented in this summary will be presented elsewhere.

[1]Aquitaine Company of Canada Ltd., Windsor, Nova Scotia.

During the summer of 1979, mineralization was discovered by ground scintillometer prospecting at Upper Salter Lake, approximately 1.5 km west of the C1 and C2 zones. A total of 23 diamond-drill holes were drilled between November 1980 and March 1981, outlining a mineralized zone extending 240 m in strike length in a northeasterly direction. The deepest hole intersected 0.116 per cent U_3O_8 over 8.9 m (5.4 m true width) at a vertical depth of 125 m. To date 139 diamond-drill holes totalling 11 342 m have been drilled on the property. Total reserves to date in the three zones are about 1.0 million lb. U_3O_8 with an average grade of 0.15 to 0.20 per cent U_3O_8, using a cutoff of 0.10 per cent over 2.0 m width.

The uranium mineralization at Millet Brook occurs in closely spaced en-echelon pods and lenses which are confined to northeast trending shear and fracture zones, extending over 1100 m. The host rock is the 370 Ma old biotite granodiorite, which is the least differentiated phase of the granitoid rocks of the South Mountain batholith. A 150 sample suite, collected from 7 diamond-drill holes and surface samples, has been investigated to illustrate quantitatively the changes in mineral and rock composition that occur near the mineralized fractures, and the nature and extent of mineral equilibria developed under magmatic and hydrothermal environments.

The mineralogy and chemistry of the unaltered granodiorite is typified by quartz, normal and oscillatory zoned calcic plagioclase (Fig. 2), perthitic K-feldspar ($Or_{90}Ab_{10}$), biotite (F/M=2.04) with average composition: $(K_{1.90}Mg_{1.47}Fe_{2.99}Mn_{0.03}Ti_{0.40}Al_{0.72}Si_{5.4}Al_{2.6}O_{22})$, muscovite $(K_{0.93}Na_{0.08}Fe_{0.26}Mg_{0.21}Ti_{0.04}Al_{2.60}Si_{3.23}O_{10})$ and an assemblage of accessory minerals which include garnet (Mn-rich), apatite, zircon, pyrite, pyrrhotite, ilmenite and rutile. Chemical characteristics (Table 1) include normative C=2.5, DI=79, N magnetite/N ilmenite 0.50, Ba:Sr:Rb=67:15:18, $\bar{x}$ U=5.8 ppm, $\bar{x}$ Th=10.9 ppm (U/Th=0.53), $\bar{x}$ B=4.0 ppm and an insignificant correlation (R=0.130) between Mg and Li (Fig. 3).

The altered granitoid rocks which are generally confined to within 30 m of the mineralized fractures include potassic, sodic, calcic and ferruginous varieties of granodiorite (see Table 1 for appropriate chemical data). The mineralogical changes include albitization, muscovitization, biotitization, chloritization, K-feldspathization, and carbonitization. In general, the altered rock has a varied and complex mineralogy and the composition of the secondary minerals is dependent on the composition of the pre-exiting primary magmatic mineral from which it has been derived. For example, rapakivii mantling (An < 5, compositional zoning is illustrated in Figure 2) of earlier feldspars, development of phengites and chlorites from biotite resulting in a positive correlation (R=0.89) of $Mg/Mg + Fe_{(t)}$ ionic ratio between chlorites and phengites, and the development of secondary biotites which show systematic changes in X_{annite} 0.654 to 0.597, Al^{VI} 0.68 to 0.87 and octahedral Ti 0.40 to 0.60 adjacent to the mineralized fractures. Geochemically, the hydrothermally altered granodiorites are characterized by large standard deviations in major oxides and trace elements when compared to the unaltered granodiorite. The Harker's variation diagrams are generally

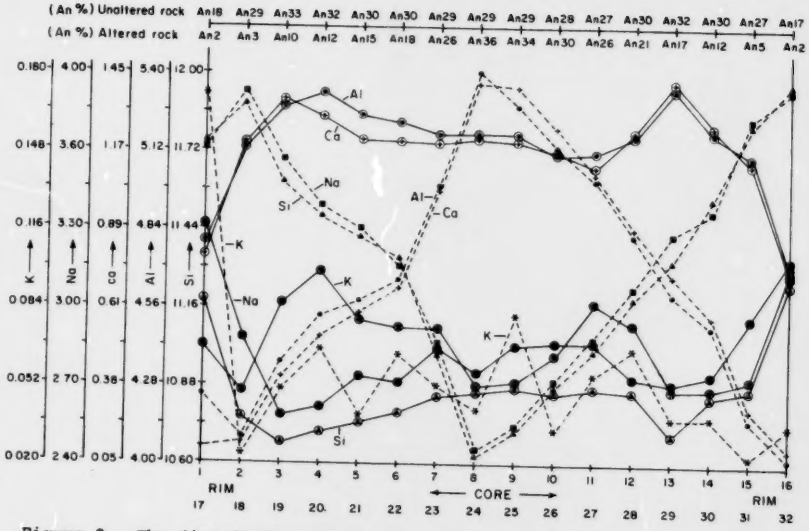

Figure 2. The distribution of Si, Al, Ca, Na, and K in the unit cell of a single zoned plagioclase feldspar from the unaltered (curves with solid lines) and altered (curves with broken lines) granodiorites of the Millet Brook area. Appropriate An content of the plagioclase composition is given at the top horizontal axis and the numbers at the bottom horizontal axis correspond to the microprobe spot analysis on a traverse across the feldspar grains. Each analysis represents an average of 4 spot analyses. Numbers 1 to 16 represent the data for the unaltered granodiorite, and 17 to 32 refer to the data from the plagioclase grain of the altered granodiorite.

unsystematic and often in contradictory relationships when compared with the normal co-magmatic differentiated suite. The normative corundum values range from 0 to 6.4, N magnetite/N ilmenite values range from 0.20 to 6.0, $\bar{x}$ U=107 ppm, $\bar{x}$ Th=10.0 ppm (U/Th=10.7), $\bar{x}$ B=80 ppm and a significant positive correlation between Mg and Li (R=0.46 to 0.84 for various altered rock types, Figure 3). The binary Mg+Fe+Ti vs K-Na-Ca variation diagram (Fig.4), the ternary B:Li/10:F/100 (Fig. 5) and the U:Li/10:F/100 (Fig. 6) diagrams show a systematic and progressive chemical evolution within various types of the granitoid rocks and it is suggested that the observed evolution ultimately culminated in the deposition of the uranium mineralization at Millet Brook.

The ore mineralogy is dominated by pitchblende, torbernite, autunite and Pb-meta-autunite and minor amounts of chalcopyrite, bornite, covellite, chalcocite, proustite, galena, sphalerite, saleite and wolframite. The associated gangue minerals are quartz, feldspars, micas, illite-smectites, andalusite, hematite, kaolinite, tourmaline, chlorites, calcite-ankerite, pyrite, Mn-oxides, and anatase.

Table 1. Major oxides, CIPW norms, norm ratios, selected trace elements, elemental ratios and various element proportions for the granodiorites of the Millet Brook area. Analyses numbers 1 to 8 are the mineralized granodiorites, 9 to 20 are the altered granodiorites and 21 is the mean value (N=45), and the column 22 shows the range of values of 95% confidence interval, of the unaltered granodiorite. Column 24 represent the average granodiorite of the South Mountain batholith (McKenzie and Clarke, 1975).

No.	1	2	3	4	5	6	7	8	9	10	11	12
Oxides	7m1-83	7m1-84.1	7m1-85	7m1-84.4	m83-47	m111-3.7	71.1(7)	b.r. (21)	m113-21.9	7m1-25.5	m110-10	m111-28.1
SiO_2	69.36	71.19	72.75	66.20	55.43	63.13	64.30	64.80	72.72	70.77	70.53	69.51
TiO_2	0.61	0.53	0.57	0.63	0.57	0.76	0.63	0.73	0.59	0.75	0.72	0.73
Al_2O_3	14.87	13.72	13.33	16.33	15.30	14.34	15.00	15.36	13.77	13.95	13.73	14.31
Fe_2O_3	3.73	3.28	3.32	3.95	3.90	3.77	3.91	3.78	3.25	3.24	3.04	3.47
FeO	2.72	2.53	2.40	3.0	2.51	3.34	3.0	3.0	2.46	3.38	3.58	3.37
MnO	0.05	0.06	0.06	0.06	0.07	0.07	0.06	0.06	0.03	0.09	0.07	0.08
MgO	1.22	1.06	1.4	1.13	3.43	3.07	2.45	2.07	0.92	1.12	1.09	1.16
CaO	2.66	2.23	2.15	3.62	7.26	5.23	5.23	3.48	2.35	2.70	1.95	2.55
Na_2O	3.23	3.00	2.53	3.08	3.24	3.57	4.07	3.76	4.78	3.61	3.42	3.47
K_2O	3.38	3.72	3.79	3.37	2.38	2.77	3.24	3.17	2.89	3.58	3.17	3.00
H_2O^+	2.23	1.74	1.38	1.29	1.40	0.91	0.70	0.89	1.59	1.30	0.88	1.14
H_2O^-	0.30	0.25			0.67	0.07	0.06	0.05	0.23	0.26	0.13	0.30
P_2O_5	0.23	0.23	0.23	0.28	0.36	0.29	0.23	0.36	0.17	0.24	0.19	0.26
CO_2	0.32	0.31	0.58	0.32	0.86	0.07	0.36	0.32	0.07	0.33	0.02	0.07
Total	99.67	98.84	100.58	100.00	98.36	97.76	100.07	98.00	100.97	100.21	99.97	100.17

Norm (Weight Per Cent)

Quartz	34.93	38.59	37.19	23.67	29.80	17.04	19.32	23.14	33.05	32.67	33.79	33.03
Corundum	0.70	1.57	0.58	1.25	0.00	3.32	2.19	2.62	2.08	2.25	1.58	2.55
Orthoclase	19.63	20.27	19.25	18.35	13.99	15.74	19.26	18.83	26.42	20.57	20.68	20.70
Albite	28.29	25.83	21.95	26.05	29.35	24.58	29.62	25.97	23.09	30.37	27.03	25.67
Anorthite	9.79	2.83	2.70	5.80	23.52	5.33	6.23	6.39	3.29	2.30	6.52	8.70
Enstatite	3.09	2.72	2.93	2.85	1.64	2.75	1.99	2.44	2.35	3.33	2.76	2.87
Ferrosilite	2.62	3.07	3.18	1.04	3.07	0.00	1.68	1.67	3.47	3.79	5.03	4.24
Magnetite	2.58	3.40	3.05	3.19	2.77	0.52	0.20	5.82	0.35	3.79	0.68	1.42
Ilmenite	1.33	1.36	1.12	1.19	1.12	1.49	1.16	1.41	1.11	1.64	1.36	1.49
Apatite	0.52	0.48	0.47	0.54	0.38	0.43	0.42	0.48	0.40	0.54	0.40	0.42
Calcite	0.28	0.73	1.34	0.27	1.38	0.14	0.19	0.28	0.14	0.64	0.05	0.14

Norm Ratios (Weight Per Cent)

Or:Ab:An	39:58:3	37:58:5	42:50:8	46:45:9	41:37:11	41:47:10	50:58:8	51:46:11	51:43:6	39:57:4	36:60:4	38:47:15
Q:Ab:Or	62:35:23	65:34:23	59:22:19	27:30:37	36:33:35	49:33:28	38:33:29	37:33:30	39 38:33	39:36:25	40:34:26	41:33:25
Mt:I:A	10:35:55	9:30:53	12:40:48	8:29:63	9:36:55	7:53:40	0:12:82	7:40:47	0:26:68	11:34:55	9:34:57	10:35:54
Di	84	85	80	81	69	79	83	79	88	88	79	78

Trace Elements (PPM)

Be	440	190	480	750	500	500	1000	550	790	370	560	500
F	320	280	490	430	520	470	340	430	420	440	560	630
Rb	120	120	117	90	152	107	108	140	180	160	150	165
Sr	60	170	52	164	65	153	170	129	112	172	130	155
U	400	614	1260	196	2020	1175	3180	910	17	11	19	65
B	61	44	70	136	95	54	150	145	19	26	9	16
Li	95	101	95	96	65	81	158	101	67	94	66	82
Co	99	0	10	0	96	26	36	28	0	10	6	9
Ni	14	14	17	16	99	16	16	16	15	7	9	16
Th	8	9	8	7	9	9	0	0	10	12	10	12
U/Th	57.58	70.44	757.5	45.46	224.44	130.55	397.50	117.25	1.70	0.91	1.90	5.41
Co/Ni	1.36	0.64	1.76	0.50	2.40	1.50	2.57	1.75	0.00	1.42	0.66	0.57
Ba:Sr:Rb	70:12:18	61:16:23	69:11:20	69:15:16	70:11:19	68:13:19	76:12:12	68:16:16	70:11:19	68:18:22	65:17:18	61:19:20
K:Li/Mg:F/Mg	83:13:4	76:18:6	83:11:6	90:7 :3	58:23:19	57:29:14	91:0 :9	88:11:1	60:27:13	68:24:8	39:37:24	53:27:20
U:Li/Mg:F/Mg	97:2 :1	97:2 :1	98:1 :1	98:3 :1	98:1 :1	97:2 :1	97:2 :1	97:2 :1	74:18:8	41:36:23	57:26:17	68:19:9

No. / Oxides	13 8011-34.5	16 8011-43.8	15 8011-27.9	70 701-35.56	17 8011-56.7	18 8010-25	19 8010-16.7	20 8010-17.1	21 n=45*	22 86	23 95 C.L.	24 Av.Grano-Alkalite Suite
SiO_2	66.04	67.10	66.20	68.54	67.10	65.20	66.61	66.15	68.31	1.280	67.92-68.69	66.40
TiO_2	0.66	0.58	0.83	0.67	0.81	0.59	0.69	0.64	0.75	0.757	0.718-0.796	0.61
Al_2O_3	16.51	15.38	15.55	15.12	15.64	16.51	15.75	17.11	14.80	0.721	14.58-15.01	16.36
Fe_2O_3	1.36	0.79	0.66	0.97	1.18	0.33	0.96	0.74	0.56			0.64
FeO	3.00	4.06	3.69	3.67	3.36	3.27	3.48	2.75	3.72	0.401	3.59-3.84	3.32
MnO	0.09	0.08	0.08	0.07	0.07	0.06	0.07	0.05	0.07	0.009	0.067-0.072	0.10
MgO	1.33	1.02	1.25	1.30	1.11	1.06	1.23	1.06	1.23	0.220	1.165-1.297	1.02
CaO	1.36	2.20	2.17	1.72	1.26	2.20	1.64	1.72	1.72	0.401	1.608-1.847	1.93
Na_2O	3.49	3.78	3.91	3.74	5.24	5.33	4.86	4.35	4.02	0.605	3.936-4.199	3.88
K_2O	4.97	3.17	3.96	4.13	3.46	3.58	3.90	3.58	3.35	0.286	3.167-3.339	3.29
H_2O^+	1.00	0.99	1.17	1.06	0.93	1.06	1.11	1.30	1.02	0.254	0.942-1.095	0.80
H_2O^-	0.25	0.10	0.15	0.23	0.13	0.13	0.08	0.16	0.11	0.061	0.089-0.127	-
P_2O_5	0.23	0.21	0.23	0.23	0.18	0.21	0.22	0.19	0.22	0.082	0.201-0.250	0.11
CO_2	0.09	0.21	0.09	0.06	0.05		0.08	0.08	0.12	0.083	0.096-0.146	-
Oxides	99.38	100.59	100.64	99.66	100.37	99.66	99.99	100.27	99.92	-	-	-
Norm (Weight Per Cent)												
Quartz	24.13	25.60	20.70	28.85	23.38	18.56	26.36	18.53	27.49	-	-	27.96
Corundum	4.43	3.10	3.34	4.17	2.66	1.47	3.43	3.79	2.01	-	-	1.47
Orthoclase	31.02	22.50	12.01	26.39	21.23	22.04	29.26	26.83	24.08	-	-	23.30
Albite	35.07	27.00	33.50	35.39	26.85	30.09	25.00	30.32	27.85	-	-	28.19
Anorthite	4.78	9.26	10.52	3.54	9.37	9.44	8.49	6.86	6.61	-	-	9.03
Hematite	3.30	3.95	3.56	3.49	2.76	2.68	3.99	3.67	3.98	-	-	7.98
Perrosilite	3.60	5.42	5.25	5.75	3.99	6.92	6.25	3.43	5.29	-	-	Hy -
Magnetite	1.95	1.02	0.96	1.39	1.72	0.48	0.24	1.09	0.82	-	-	0.82
Ilmenite	1.28	1.07	1.77	1.29	1.74	1.12	1.33	1.33	1.44	-	-	1.17
Apatite	0.55	0.47	0.47	0.54	0.42	0.47	0.52	0.42	0.51	-	-	0.22
Calcite	0.19	0.50	0.19	0.12	0.07	0.12	0.17	0.12	0.27	-	-	-
Norm Ratios (Weight Per Cent)												
Or:Ab:An	35:58:8	39:47:14	23:59:18	38:64:6	49:42:9	44:43:13	48:47:11	52:42:6	41:48:11	-	-	39:47:14
Q:Ab:Or	39:44:25	33:35:30	38:45:17	36:44:20	29:33:38	23:29:48	31:32:37	28:36:36	36:35:31	-	-	35:35:30
Mf :A	9:32:59	11:36:53	11:38:51	11:35:54	9:31:61	8:36:56	9:31:60	7:36:57	10:33:57	-	-	-
DI	80	76	75	80	82	70	79	66	79	-	-	79
Trace Elements (PPM)												
Ba	530	730	670	650	910	880	750	1000	622	155.15	575-669	667
F	660	630	620	630	520	510	540	890	520	0.009	490-550	-
Rb	165	96	133	176	150	164	216	200	160	23.73	151-175	162
Sr	230	165	117	140	195	185	120	152	120	20.07	110-104	150
U	11	10	24	22	12	19	14	12	5.0	3.265	4.0-6.0	-
B	17	27	24	27	16	6	8	7	6	0.624	6.2-6.6	-
Li	92	80	64	104	72	77	95	80	91	12.12	75.3-87.3	-
Co	6	11	12	9	7	6	6	4	7	2.066	6.6-7.8	-
Ni	17	16	15	4	10	11	10	12	12	3.51	10.76-12.8	-
Th	11	9	15	8	10	10	11	9	10.9	1.01	10.38-11.47	-
U/Th	10.27	5.25	1.60	2.75	1.20	1.90	1.07	1.33	0.53	-	-	-
Co/Ni	0.35	0.68	0.80	1.75	0.70	0.54	0.60	0.33	0.58	-	-	-
Ba:Sr:Rb	39:25:36	69:15:16	69:17:14	59:16:25	73:14:13	70:19:11	69:11:20	76:11:13	67:19:14	-	-	69:16:17
U:Li/ Th:F/ 100	81:13:6	67:22:11	62:22:16	65:25:10	56:25:19	32:41:27	38:36:27	29:34:37	23:47:30	-	-	-
U:Li/ Th:F/ 100	69:7 :4	78:12:10	62:22:16	60:28:12	49:30:21	60:28:16	46:29:25	41:29:30	30:42:28	-	-	-

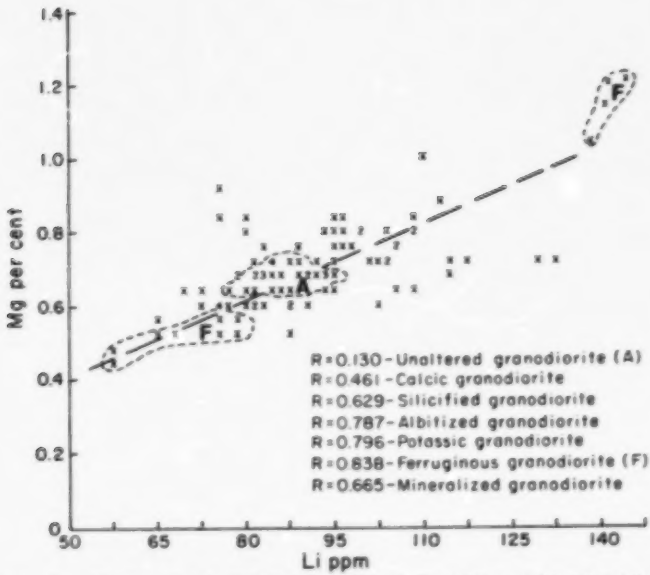

Figure 3. The Mg vs Li variation diagram for the granitoid rocks of the Millet Brook area. The numbers corresponding to the various rock types are the calculated values of the correlation coefficient. The values for the unaltered granodiorite mostly fall within the area designated as A and the two areas designated as F show the clustering of data in two distinct populations for the ferruginous granodiorite.

The application of some of the calibrated silicate and sulphide mineral geothermometers for the rocks of the Millet Brook area record three different temperatures viz., muscovite + aluminum silicate + K-feldspar at $P_{H_2O}=P_t$=4200 bars, 670°±10°C; $NaAlSi_3O_8$ partitioning between plagioclase and K-feldspar, 425±25°C; and a maximum of 380°C for the formation of pyrrhotite-chalcopyrite pair and a minimum of 248°C for the formation of hexagonal pyrrhotite. These three deduced temperatures, respectively, correlate with (but not necessarily record) the crystallization of the biotite granodiorite, onset of a hydrothermal event that altered the granodiorite, and then followed closely by a mineralizing event during which the uranium mineralization at Millet Brook took place.

It is proposed that the formation of uranium mineralization at Millet Brook is related to the late stages of felsic magmatism resulting in the formation of specialized autometasomatic leucomonzogranite in the New Ross area. One such body, the Lake Lewis pluton, is characterized by $\bar{x}$ U=13.6 ppm, $\bar{x}$ Th=5.2 ppm, $\bar{x}$ Li=517 ppm, and $\bar{x}$ F=4530 ppm. It is

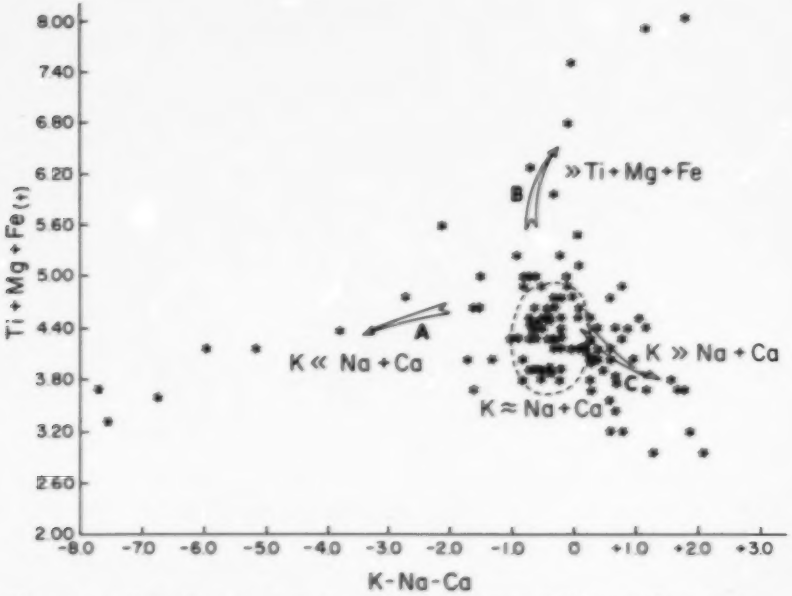

Figure 4. $Ti+Mg+Fe_{(t)}$ vs K-Na-Ca variation diagram showing various types of alterations associated with the uranium mineralization at Millet Brook. The area enclosed by the dashed line represents unaltered wall rocks where K-Na-Ca value is approximately zero. The arrows designated as A, B, and C show the evolutionary trends towards albitization, hematitization and K-feldspathization respectively.

demonstrated that this pluton has lost approximately 70 per cent of its original U content from the top 100 m (Fig. 7) and the hydrothermal fluids, from such a pluton, were evolved by second boiling, which in turn determined the fracturing of the granodiorite and subsequent hydrothermal activity (Fig. 8). Though speculative, we believe that the fracturing in the granodiorite is largely due to the release of mechanical energy (PaVr) from the underlying cupola of the leucomonzogranite which for X_{v}=0.24 would produce extensive fracturing probably at Pa2 kbar of load pressure. Mineral composition data indicate that the fluids involved in the hydrothermal event contained CO_2 - H_2O and the precipitation of pitchblende took place by the unmixing of the complex CO_2 - H_2O volitile phase, following a drop in pressure of CO_2.

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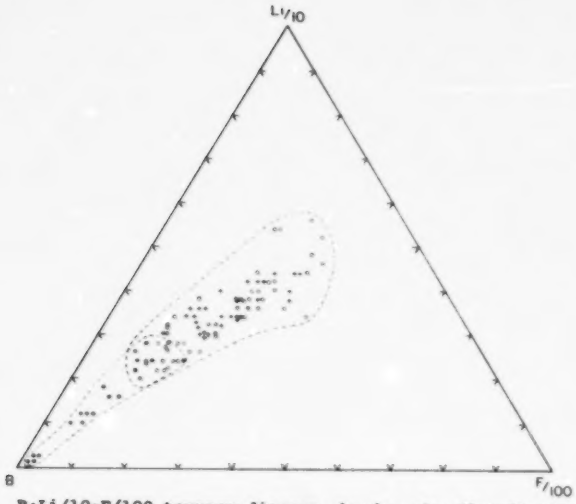


Figure 5. B:Li/10:F/100 ternary diagram showing the distribution of the unaltered (+), altered (0), and the mineralized (*) granodiorites of the Millet Brook area.

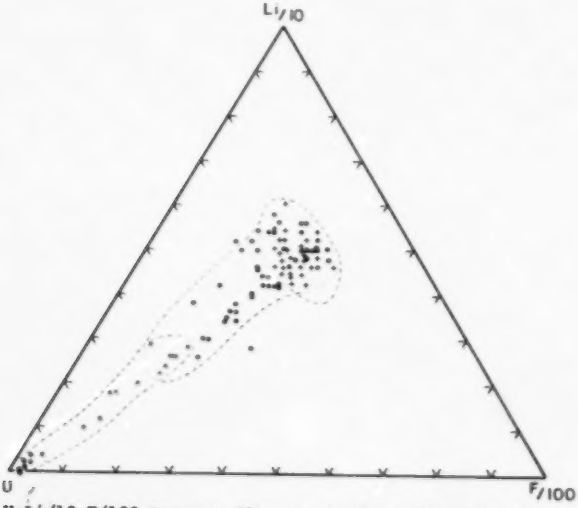


Figure 6. U:Li/10:F/100 ternary diagram showing the distribution of the unaltered (+), altered (0), and the mineralized (*) granodiorites of the Millet Brook area.

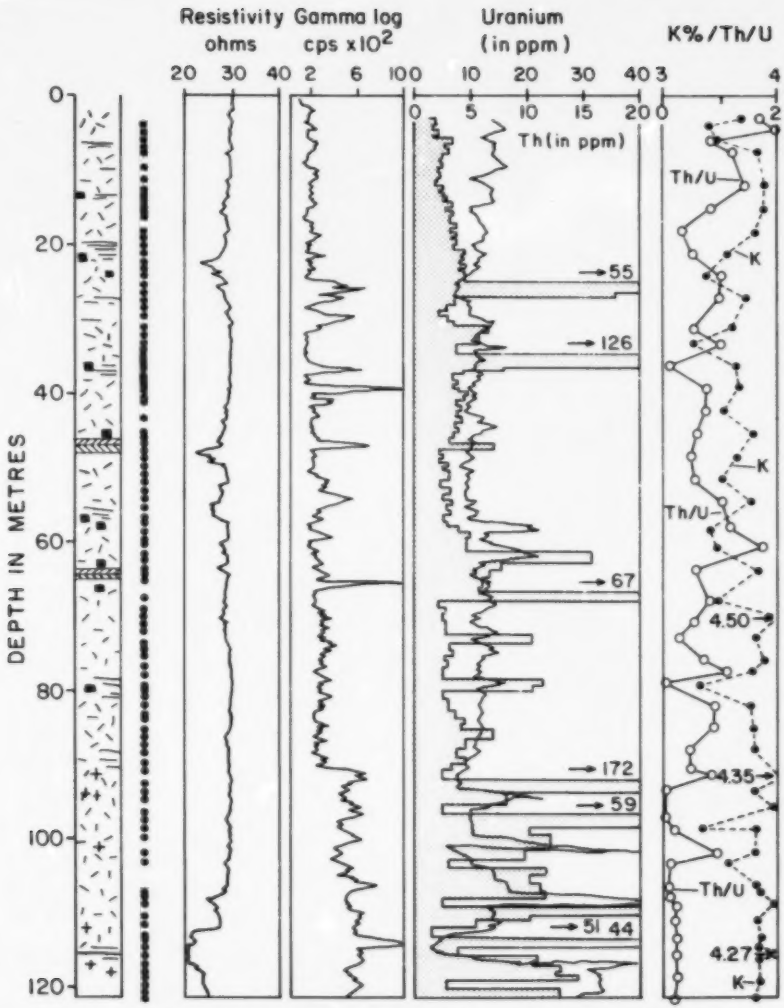
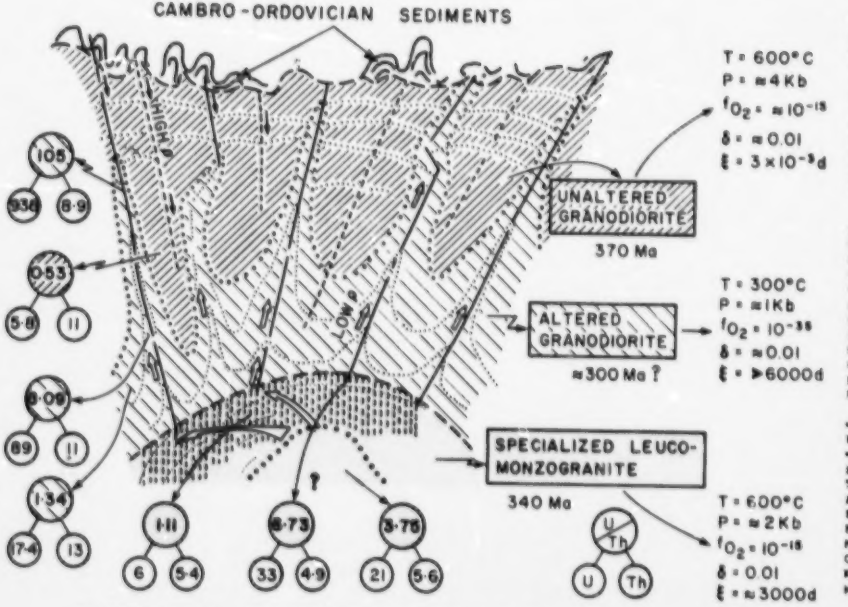


Figure 7. The vertical distribution of the radioelements in a drill-hole within the Lake Lewis pluton.



A MODEL FOR THE URANIUM MINERALIZATION · MILLET BROOK

N = 45 Unaltered granodiorite

SiO_2	68.31	1.28	Rb	168	22
TiO_2	0.75	0.12	Ba	622	155
Al_2O_3	14.80	0.72	Sr	139	20
Fe_2O_3	0.56	0.42	Cu	29	52
FeO	3.72	0.40	Pb	27	12
MgO	1.23	0.22	Zn	141	75
CaO	1.72	0.40	U	5.8	3.2
K_2O	4.02	0.60	Th	10.9	1.8
Na_2O	3.25	0.28	Li	78	4.2
			F	520	9

N = 51 Altered Granodiorite

SiO_2	68.07	3.12	Rb	167	24
TiO_2	0.71	0.11	Ba	698	245
Al_2O_3	14.76	1.46	Sr	137	29
Fe_2O_3	4.55	0.97	Cu	74	219
FeO	3.34	0.57	Pb	43	48
MgO	1.16	0.20	Zn	178	167
CaO	1.82	1.61	U	107	345
K_2O	4.22	0.98	Th	10	3.4
Na_2O	3.23	0.39	Li	87	15
			F	520	10

N = 135 Specialised Leuco-monzogranite

SiO_2	74.47	0.96	Rb	769	62
TiO_2	0.08	0.02	Ba	39	24
Al_2O_3	13.90	0.55	Sr	38	12
Fe_2O_3	1.29	0.13	Cu	30	25
FeO	0.93	0.08	Pb	5	3.6
MgO	0.07	0.04	Zn	85	21
CaO	0.75	0.14	U	13.6	20.7
K_2O	4.39	0.38	Th	5.2	1.9
Na_2O	3.48	0.27	Li	517	47
			F	4530	610

Major Oxides	$\bar{X}$	Sd	Trace elements	$\bar{X}$	Sd

Figure 8. The geological, petrometallogenic and physio-chemical considerations of a semiquantitative model for the uranium mineralization in the granitoid rocks of the Millet Brook area.

CARBONIFEROUS STUDIES

P. S. Giles and R. C. Boehner

No new field programs were undertaken by project staff during the summer of 1981. Major efforts have been directed towards completion and publication of maps and reports dealing with the Windsor Group in the Shubenacadie, Musquodoboit and Antigonish Basins (Fig. 1). Reports are also in preparation dealing with the Windsor Group of the Mahone Bay area, Lunenburg County (PSG), and the Eureka area, Pictou County (PSG) as well as the Loch Lomond area (RCB) of southeastern Cape Breton Island.

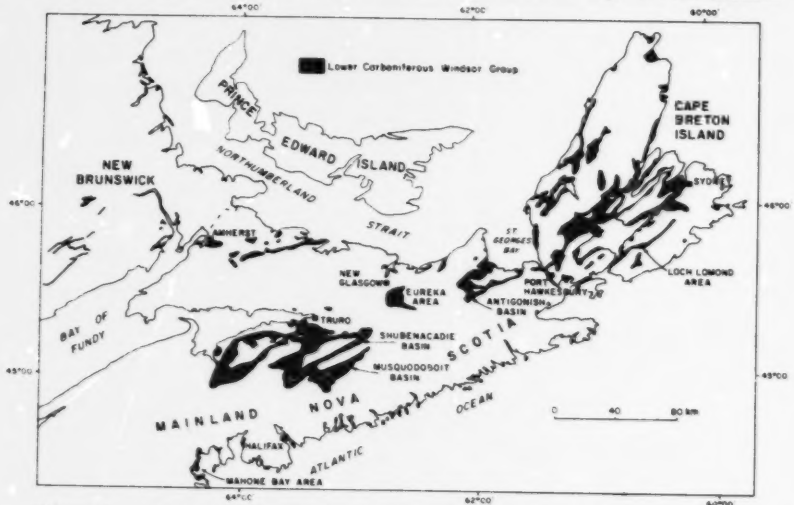


Figure 1. Location map showing the distribution of the Windsor Group and the areas referred to in this manuscript.

A summary report and thorough compilation of all data pertaining to salt (and potash) resources in Nova Scotia (RCB) is in the review process. An overview study of Windsor Group stratigraphy (PSG) emphasizing the cyclic nature of deposition and the relationships between rock units and biostratigraphic units was published in 1981. Abstracts of recently released publications are included elsewhere in this volume.

A preprint of a paper by R. C. Boehner dealing with the stratigraphy and depositional history of evaporitic rocks in the Shubenacadie and Musquodoboit Basins (to appear in Compte Rendu, 9th International Congress of Carboniferous Stratigraphy and Geology), has been released as Nova Scotia Department of Mines and Energy Open File Report 468. A geological map of the Eureka map area (PSG) has been recently released as Open File Report 475, and deals mainly with rocks of the Windsor and Canso Groups.

Studies in progress in the fall of 1981 include an examination of the stratigraphy and sedimentology of the Horton Group in the Shubenacadie Basin (PSG) and an assessment of its potential for placer gold deposits. This application of paleogeographic modeling to mineral exploration is largely untested but intriguing.

Studies in the Loch Lomond area (RCB) include preliminary geochemical investigations of carbonate and evaporite rocks. This research will hopefully aid in achieving a better understanding of the genetic controls over celestite, barite and base metal mineralization in that area.

Compilation, on a regional scale, of all geochemical data pertaining to salt springs in Nova Scotia (RCB) is in progress. These data will supplement the major report on salt resources, nearing completion. R. C. Boehner is also compiling , at a scale of 1:250 000, all available Bouguer Anomaly maps for the Carboniferous basins of Nova Scotia, to provide more ready access to this type of information.

The study of the Windsor Group has lead to a new understanding of stratigraphic relationships throughout a large portion of Nova Scotia. Synthesis of these new stratigraphic data is feasible in some areas, permitting some attempts at paleogeographic reconstruction. Construction of depositional and paleogeographic models for southern mainland Nova Scotia is in progress (PSG). Concurrent advances in the knowledge of the tectonic and structural history, and in the understanding of regional metallogeny, will add a new and stimulating dimension to studies of the Carboniferous basins of Nova Scotia.

SUBDIVISION AND REGIONAL CORRELATION OF STRATA OF THE UPPER WINDSOR GROUP, CAPE BRETON ISLAND AND CENTRAL NOVA SCOTIA

P. S. Giles and R. C. Boehner

INTRODUCTION

Throughout the Carboniferous basins of Nova Scotia, exposures of (Visean) Windsor Group marine rocks are limited mainly to strata of the upper part of the Group. This natural bias reflects the relatively resistant character of these rocks compared to the evaporite-dominated lower part of the Windsor succession.

During the past several years, detailed studies of the Windsor Group have permitted continuing advances in our knowledge of the Upper Windsor in various parts of Nova Scotia. This brief report provides a preliminary statement of our current thoughts regarding the regional correlation of the carbonate marker horizons used traditionally to subdivide the Upper Windsor (Stacey, 1953; Sage, 1954: Moore, 1967; Giles and Boehner, 1979).

DEFINITION OF THE UPPER WINDSOR GROUP

The designation "Upper Windsor" was first used by Bell (1929) to delineate a faunal zone, the zone of *Martina galataea*. The zone comprised subzones C, D, and E in ascending order, each characterized by faunal assemblage. The faunal assemblage characteristic of subzone C appears regionally within the Herbert River Limestone Member of Moore (1967), the base of which is defined as the lithostratigraphic base of the "upper part" of the Windsor Group. Arguments for this definition were presented by Moore (1967) and are fully accepted by the present writers. Thus, as presently understood, the base of the Upper Windsor Zone of Bell (1929) coincides with the lithostratigraphic base of the Upper Windsor.

The top of the Upper Windsor (biostratigraphic) Zone is defined by the upper limit in the succession of the marine fossils which are used to define the zone. In the type area of the Windsor Group, these fossils have not been noted above the top of the Kennetcook Limestone Member of Moore (1967) (Moore and Ryan, 1976). Thus, the zonal boundary coincides with the top of the Kennetcook, the highest marine carbonate member in the type Windsor.

Several definitions have been proposed for the top of the Windsor Group, i.e. the top also of the Upper Windsor (Group). Bell (1927) defined the top of the Group as the top of the stratigraphically highest marine stratum. Moore (1967) apparently followed this definition and included gypsum and shales of probable marine origin within the "upper part" of the Windsor Group although no marine fossils were known in those beds.

Keppie et al. (1978) proposed that, in areas where marine strata of Visean age were intercalated with continental strata, and where local unconformities truncated the succession, the boundary be drawn at the unconformity and not at the top of the locally highest marine stratum. The concept of using the highest marine stratum, non-specific as to lithologic character, was accepted for defining the top of the Group where complete.

Giles and Boehner (1979) and Giles (1981b) adopted a different position in defining the top of the Windsor Group as the top of the Kennetcook Limestone Member or a locally equivalent carbonate member. The arguments for this more restricted definition are summarized as follows:

(a) The Kennetcook Limestone (Moore, 1967) or its equivalent, the E_1 limestone of Stacey (1953) (Giles, 1980), is the highest stratum readily proven to be of marine origin by virtue of its contained fossils. Thus, the original concept of Bell (1927) is accommodated.

(b) The defined top of the Group is here specific as to rock type and lithologic marker horizon and is therefore defined in a manner consistent with modern lithostratigraphic practice.

(c) The Kennetcook and E_1 limestones are relatively resistant, thick carbonate units which have been shown to have practical value for purposes of geological mapping (Giles and Boehner, 1979; Boehner and Giles, in press).

The Upper Windsor, as defined here therefore, extends stratigraphically from the base of the Herbert River Limestone Member (or its local equivalent) to the top of the Kennetcook (or E_1) Limestone Member. On-going research by the present writers suggests that, with the possible exception of the Cumberland sub-basin area of northern Nova Scotia, the above definition is both practical and useful throughout the Province. As research continues, local or perhaps regional change in definition may become necessary.

SUBDIVISIONS OF THE UPPER WINDSOR

In typical field exposures, Upper Windsor rock types include fine grained red sandstones and siltstones with subordinate rhythmically intercalated marine limestone and dolostone and relatively minor gypsum and/or anhydrite. Detailed studies have traditionally concentrated on the carbonate beds because of their utility as marker horizons.

Stacey (1953) and Sage (1954) applied an alphanumeric coding system to identify Windsor carbonate members in the Antigonish area and throughout much of Cape Breton Island. The carbonate marker beds (members) were thereby assigned to subzone (C, D, or E) and also to their relative position in ascending sequence (C_1, C_2 C_3, etc.). Informal descriptive names such as "Giant Ripple Limestone" also were sometimes applied. Members thus designated by Stacey (1953) include the C_1, C_2, C_3, D_1, D_2, D_3 and E_1 "limestones".

Moore (1967) formally described and defined several discrete carbonate members in the Upper Windsor of southern Nova Scotia. These were named (in ascending order) the Herbert River, Brooklyn Station, Avon, Meander River, Wallace Point, and Kennetcook Limestone Members. An additional member, termed the Shubenacadie Limestone Member, was recognized in the Green Oaks area (Fig. 1). The Shubenacadie was tentatively equated with the Brooklyn Station Limestone Member (Moore, 1967, p. 254).

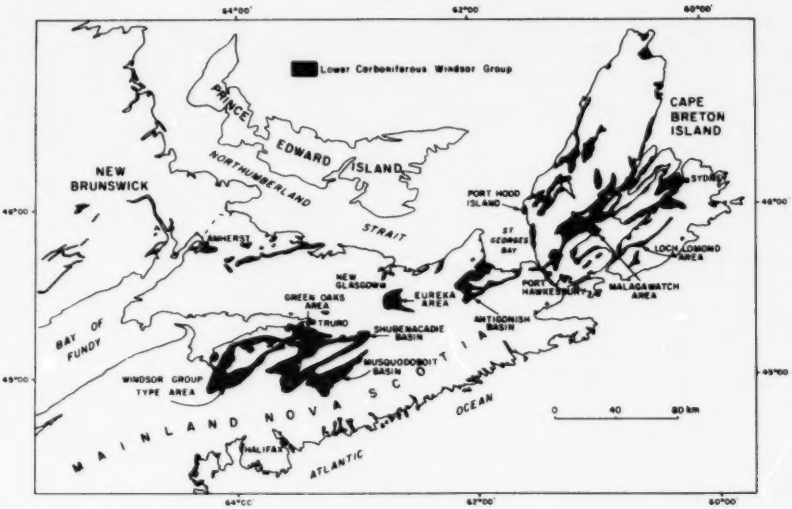


Figure 1. Location map.

Giles and Boehner (1979) recognized each of the members defined by Moore (1967) and added two additional members, based on the complete(?) and structurally little disturbed section preserved in the Shubenacadie Basin (Fig. 1) of central Nova Scotia. The lithological designation was dropped from the member names because of potential confusion in naming a unit composed entirely of dolostone, a "limestone" member. The members recognized by Giles and Boehner (1979) include, in the C subzone of Bell (1929), the Herbert River, Kent Road, Shubenacadie and Green Creek Members (Brooklyn Station equivalent); in the D subzone, the Avon and Meander River Members; and in the E subzone, the Wallace Point and Kennetcook Members (Table 1).

Crowell (1971), Forgeron (1977) and Boehner (1981) applied the name Wavy limestone to a carbonate member found at the base of the Upper Windsor in the Loch Lomond area (Fig. 1) of southeastern Cape Breton Island. Other members in the same area were identified according to the alphanumeric code of Stacey (1953) and Sage (1954).

Boehner (1977) and Moore and Austin (1979) named the Musquodoboit Limestone, found at the base of the Upper Windsor in the Musquodoboit Basin of central Nova Scotia. The Musquodoboit was correlated by these authors, with the Herbert River Limestone of the type Windsor.

In the Eureka area (Fig. 1) of central Nova Scotia, the carbonate member found at the base of the Upper Windsor is termed the MacLean Quarry Member by Giles (in press). This limestone is considered the lateral equivalent of the Herbert River (Limestone) Member. Additional members in the Eureka area include the East Branch, the McLellan Brook, the West Branch, and the Island Members. Regional correlation of the latter members remains uncertain.

Table 1. Regional correlation of carbonate members of the upper Windsor Group in Nova Scotia.

Subzones of Bell (1929)	(1)Port Wood Island Section	(2)Loch Lomond Section	(3)Windsor Type Area, Shubenacadie and Musquodoboit Basins
E	E_1 limestone	E_1 limestone	Kennetcook (ls) Member
	D_3 limestone	D_3 limestone	Wallace Point (ls) Member
	D_2 limestone	D_2 limestone	
	D_1 limestone	D_1 limestone	
D	C_3 limestone	C_3 limestone	Meander River (ls) Member
	C_2 limestone	C_2 limestone	Avon (ls) Member
	C_1 limestone	C_1 limestone	
C	B_3 limestone	unnamed limestone	Green Creek/Brooklyn Station (ls) Members
	?	unnamed limestone	Shubenacadie (ls) Member
		unnamed limestone	Kent Road Member
		Wavy limestone	Herbert River/Musquodoboit (ls) Members

(1) section of Stacey (1953), Sage (1954), revised by the senior author
(2) section after Boehner (1981)
(3) section after Bell (1929), Moore (1967), and Giles and Boehner (197-)

REGIONAL CORRELATION OF THE CARBONATE MEMBERS

Lithostratigraphic correlation of Upper Windsor carbonate members on a regional basis, although first attempted by Sage (1954), has not yet been satisfactorily achieved. Considering the distances between measured sections, variation in rock character is to be expected. Thus, the difficulties in member-for-member correlation can be appreciated and explained.

However, biostratigraphic data can be used alone, or can supplement lithologic criteria, to establish a reasonable regional correlation against which future work can be tested. This regional framework is summarized in Table 1 and shown in a broader stratigraphic context in Figure 2. Some of the more important evidence for the suggested correlations and several aspects which remain to be tested are discussed in the following paragraphs.

Correlation of the Kennetcook (Limestone) Member with the E_1 Limestone

Arguments for correlation of the Kennetcook and E_1 limestones were originally presented by Giles (1980), who in error attributed first suggestion of this correlation to Sage (1954). Evidence for correlation includes (a) their common stratigraphic position at the top of the Upper Windsor succession, (b) their relatively great thickness as compared with contiguous carbonate members in each of their respective outcrop areas, and

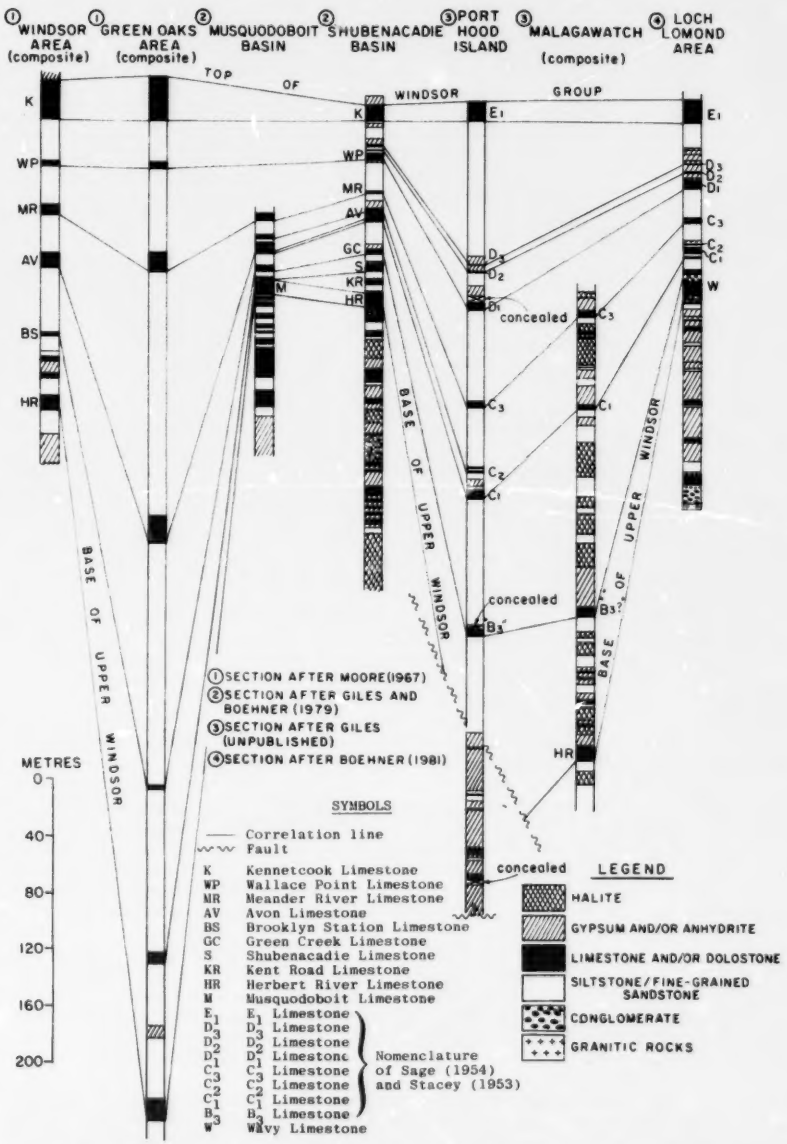


Figure 2. Regional correlation of carbonate members and associated strata in the upper part of the Windsor Group of Nova Scotia.

(c) the presence of rugose corals in the Kennetcook and E_1 faunal assemblages. In the E_1, corals occur both in the Pomquet River section (Giles, 1980) and at Point Vertical on Port Hood Island (Paul McCulloch, personal communication, 1982).

In the central portions of the Shubenacadie Basin, two heavily dolomitized sections through a carbonate member correlated with the Kennetcook by virtue of stratigraphic position (Giles and Boehner, 1979, Sheet 20) show a high degree of lithologic similarity to the E_1 of the Pomquet River section (cf. Giles, 1980, p. 189).

Correlation of the Wallace Point with the D_1, D_2 and D_3 Limestones

In the axial portions of the Shubenacadie Basin, the Wallace Point (Limestone) Member exhibits a very saline facies comprising a lower, major carbonate, separated from two lesser overlying carbonates by anhydrite and/or siltstone. The member thus consists of three discrete transgressive-regressive pulses. The sequence of rock units and their lithologic character is very similar to that determined for the D_1, D_2 and D_3 limestones of the Hood Island section by the senior author (PSG), and for the Loch Lomond section described by Boehner (1981, Fig. 4).

Biostratigraphic support for this correlation is tenuous. The restriction of *Schellwienella* to the E subzone (Bell, 1929) or to the Kennetcook (Limestone) Member (Moore and Ryan, 1976) at the top of the E subzone, suggests that its common presence in the D_1 as noted by the senior author (PSG), limits the D_1 to the E subzone as well. Because we argue that the E_1 correlates with the Kennetcook, we believe that the D_1, D_2 and D_3 correlate together with the composite saline facies of the Wallace Point Member of the Shubenacadie Basin (Fig. 2).

Correlation of the Meander River (Limestone) Member with the C_3 Limestone

Correlation of the C_3 with the Meander River (Limestone) Member is supported mainly by their stratigraphic positions within the succession in each respective "type" area. A general lithologic similarity exists, but cannot alone substantiate the correlation.

The C_3 limestone is one of the most distinctive limestone members of the Hood Island succession by virtue of the presence of large (1 m high) club-shaped algal stromatolites in the lower beds of the member. The remaining beds of the member comprise oolitic limestone with lesser bioclastic limestone.

The Meander River (Limestone) Member shares with the C_3 a well developed oolitic facies (basal) with associated algal stromalolites in the form of oncolites or rarely, small club-shaped stromatolites. The Meander River Member is more typically dominated by bioclastic and platy micritic limestone beds than by oolitic limestone (Giles and Boehner, 1979).

Correlation of the Avon (Limestone) Member with the C_1 and C_2 Limestones

In the axial regions of the Shubenacadie Basin, the Avon (Limestone) Member is preserved as a series of carbonate units representing

transgressive pulses separated by anhydrite and siltstone which record regression. The earliest transgressive-regressive pulse was of very short duration and deposited a thin (1-2 m) carbonate unit excluded from the Avon Member as defined by Moore (1967). The second transgressive pulse was the most significant event in the composite cycle, and deposited the major, lower part of the Avon Member. Later transgressive events deposited one and sometimes two additional thin carbonate units above the major unit. These thin carbonates locally were deposited directly upon the lower part of the Avon without intervening siltstone or anhydrite. In those instances, a hidden break in sedimentation is suspected (Giles and Boehner, 1979).

The main lithologic argument for correlating the Avon with the C_1 and C_2 limestones rests with the composit cyclic nature of the Avon. A thin silty carbonate located one metre beneath the C_1 might represent the pre-Avon transgressive-regressive pulse. The C_1 could represent the main body of the Avon Member, and the C_2 could represent a later pulse, similar to that overlying the major unit of the Avon.

The main biostratigraphic argument for correlation of the Avon and C_1-C_2 limestone members, is in the well-documented first appearance of *Martinia galataea* in the Avon and C_1 limestones in their respective outcrop areas (Moore and Ryan, 1976; Stacey, 1953). This brachiopod has long been considered a valuable guide fossil for the Upper Windsor. It appears instead to be a guide only to the D and E subzones (Moore and Ryan, 1976).

The correlation of the Avon Member with the C_1 and C_2 limestone members is consistent with the presence of other "Upper Windsor" members beneath the C_1, reported by Giles (1981a, 1981b) and Boehner (1981). Unfortunately, the alphanumeric designation "C_1", if the correlation postulated here is proven correct, will be quite misleading since it implies the lowest member of the C subzone group of members (Table 1).

Correlation of the Green Creek Member (?) with the B_3 Limestone

If the writers are correct in postulating correlation of the C_1-C_2 and Avon (limestone) Members, then the arbitrary assignment of members beneath the C_1 to the B subzone of Bell (1929) is no longer supported. Regional correlation of the B_3 limestone of Stacey (1953) demands first that a careful re-examination of all biostratigraphic data be undertaken. This is clearly beyond the scope of this report. However, several lithologic arguments suggest assignment of the B_3 to the Upper Windsor to be likely. These include: (a) its position beneath the C_1 (basal D subzone, Table 1) in the Hood Island section, in well-exposed, fault-free sequence, which places the B_3 limestone most logically within the uppermost part of the C subzone of Bell (1929); (b) its association with large thicknesses of red siltstone/fine grained sandstone, a characteristic of the "Upper" rather than the Lower Windsor; and (c) the presence in the Loch Lomond section (Boehner, 1981) of a lithologically identical carbonate in like stratigraphic position beneath the C_1 limestone, but underlain in turn by several thin unnamed carbonate members, and finally by the Wavy limestone, coral-bearing and equivalent to the Herbert River (Limestone) Member which defines the base of the Upper Windsor.

Correlation of the B_3 with the Green Creek Member of Giles and Boehner (1979) is tentatively based upon the common position of these members directly beneath the C_1 and Avon (Limestone) Members respectively.

Correlation of the Herbert River (Limestone) Member with the Musquodoboit, Wavy, and MacLean Quarry (Limestone) Members

Biostratigraphic evidence correlating these carbonate members is based mainly upon the presence in each of rugose corals including *Dibunophyllum lambii*. Blakeney (1974) showed the great lateral extent of the Herbert River (Limestone) Member in typical facies. Boehner (1977) and Moore and Austin (1979) showed its equivalence with the Musquodoboit limestone of differing facies. Boehner (1981) established the Wavy limestone as another facies variant of the Herbert River Member. The senior author recognizes yet another variant, in the Eureka area of Pictou County, which is termed the MacLean Quarry Member. The local base of these correlative carbonate members forms the base of the Upper Windsor as defined here.

DISCUSSION

Giles (1981b) argued that each carbonate member, as the product of a single (or composite) transgressive-regressive event, should be time-significant. Thus, these members should provide the time framework within which one can begin to construct local and (less confidently) regional paleogeographic, tectonic and metallogenic models.

The correlations suggested here are supported by lithostratigraphic evidence in varying degree, but are consistent with present macrofaunal data. Of first importance is the implied lack of coincidence between the boundaries of the subzones of Bell (1929) and the subzone boundaries recognized by Stacey (1953) and Sage (1954) (Table 1). This lack of coincidence makes the alphanumeric code for biolithostratigraphic nomenclature erected by Stacey (1953) untenable. We therefore recommend that new member names, established by modern practice in accord with the Code of Stratigraphic Nomenclature be applied in place of the coded identifiers now used. Because of general lithologic dissimilarities, it is not likely that member names defined in the Windsor and Shubenacadie areas can justifiably be applied throughout Cape Breton Island. Indeed, until the correlations proposed here are tested further and generally accepted, it would be incorrect to imply acceptance of the correlation by applying the same member name.

Until such time as new member names can be defined, we will continue to use the coded names of Stacey (1953) but will emphasize where necessary the lack of coincidence with subzone assignment.

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MINERAL OCCURRENCES IN THE COBEQUID HIGHLANDS

H. V. Donohoe, Jr.

INTRODUCTION

Ninety-four non-metallic and 80 metallic mineral occurrences have been located in the Cobequid Highlands. Some of these have been known since the early 1900's, but most are new since the 1940's to 1950's.

The purpose of this note is to draw attention to the large number of mineral occurrences which are found in varied and complex geological terranes. A short description of the geological setting of the Cobequid Highlands area follows. Further information about the detailed geology and geological history may be found in Donohoe and Wallace (1980a, b).

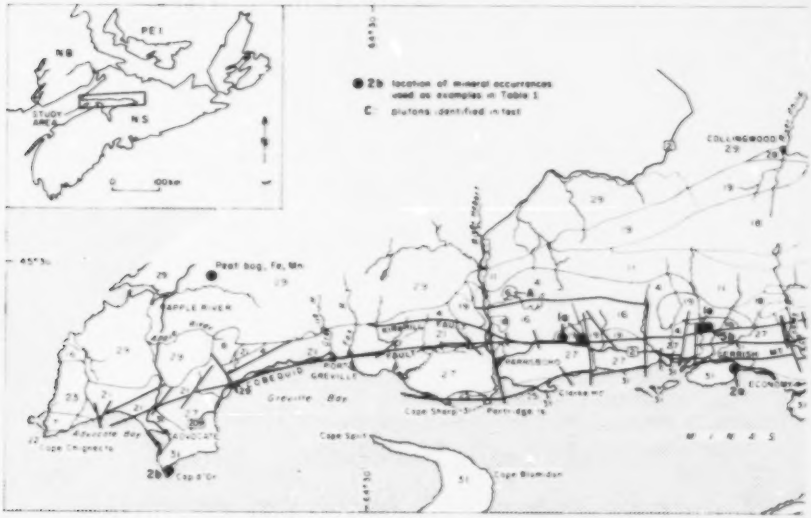
The number for each mineral occurrence in Tables 1 and 2 is located on Sheets 1 to 4 of Donohoe and Wallace (1980a).

GEOLOGICAL SETTING

The 1800 km^2 of the Cobequid Highlands are underlain by Proterozoic to Carboniferous strata. Late Carboniferous strata unconformably overly older rocks on the northern side of the Highlands. On the southern side Late Carboniferous and Triassic-Jurassic strata are in fault contact with the older rocks (Fig. 1). In the Highlands major faults separate some of the strata into linear east-west trending fault blocks.

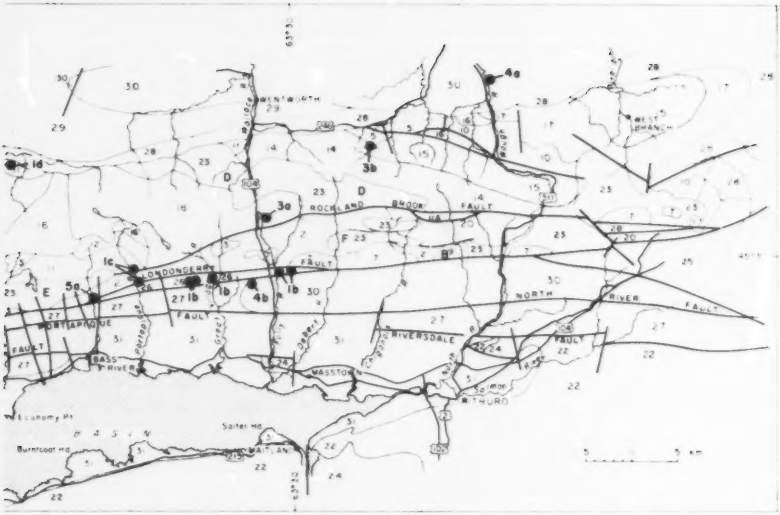
At least four major orogenies have affected various strata in the Cobequid Highlands. The Bass River and Mt. Thom Complexes have been deformed by one or more orogenies during the Proterozoic. Younger strike-slip fault movements have locally overprinted these older deformations. The younger Proterozoic rocks (Jeffers and Warwick Mountain Formations) have been multiply deformed during the Cadomian Orogeny (?Late Hadrynian). Some of the deformations occurring during these older orogenies were accompanied by garnet grade of regional metamorphism. Silurian to Early Devonian strata north of the Rockland Brook and Kirkhill Faults were folded and cleaved during the Middle Devonian Acadian Orogeny. Ordovician-Silurian and Devonian to Early Carboniferous strata south of the Rockland Brook and Kirkhill Faults have been folded and cleaved during the "Middle" Carboniferous Hercynian-Alleghenian Orogeny. Some of the deformation during this Orogeny was affected by major strike-slip fault movement (Fig. 2).

The first indirect evidence of faulting is recorded by the coarse clastic rocks of the Murphy Brook Formation (unit 13 on Figs. 1,2) during Early Devonian time. Each successive deposit of coarse clastic detritus probably represents the response to vertical movement on one or more of the various east-west faults. Many of the units containing coarse clastic rocks (such as units 17,27,28,29,30) shown on Figure 2 are interpreted as alluvial fan deposits (Donohoe and Fralick, 1980; Donohoe and Wallace, in preparation) and are related to vertical fault movement. Strike-slip movement is difficult to infer during the Acadian



Legend for the Geological Map of the Cobequid Highlands

			STRATIFIED ROCKS	PLUTONIC ROCKS
MESOZOIC	TRIASSIC TO JURASSIC		31 FUNDY GROUP: undivided, quartz, lithic, wacke, siltstone, polymictic, conglomerate; basalt flows	
PALEOZOIC	CARBONIFEROUS	Upper	30 PICTOU GROUP: gray, red wacke, siltstone, conglomerate; coal	
			29 CUMBERLAND GROUP: gray, red siltstone, wacke, coal; red-brown conglomerate	
			27 28 RIVERSDALE GROUP: (26) MOSS POINT FM.: gray, red siltstone, lithic wacke; (27) PARRSBORO FM.: gray, red wacke, siltstone	
		Lower	25 26 CANSO GROUP: (25) LONDONDERRY FM.: green, gray quartz wacke, siltstone, shale; (26) WEST BAY FM. AND CANSO GROUP: gray, red, green siltstone, wacke, shale	
			24 WINDSOR GROUP: gray limestone, red, gray siltstone, shale	23 granite (syenogranite to alkali feldspar granite; granodiorite to monzogranite)
			22 HORTON GROUP: gray, red siltstone, quartz wacke, shale	
	DEVONIAN TO CARBONIFEROUS		20 21 (21): RAPID BROOK, GREVILLE RIVER FM.: grey, tan siltstone, wacke, granite-clast, conglomerate; (20): NUTBY FM.: grey, red lithic wacke, siltstone, shale; conglomerate	19 granite (monzogranite to alkali feldspar granite)
				18 diorite
	DEVONIAN	Upper?	17 FALLS FM.: red-brown polymictic conglomerate, lithic wacke	
		Middle	(16) FOUNTAIN LAKE GROUP: (15) DIAMOND BROOK FM.: basalt flows, red, grey siltstone; (14) BIERNE BROOK FM.: tan rhyolitic, dacitic lava flows, ignimbrites, tuffs, grey siltstone	
			13 MURPHY BROOK FM.: black, grey siltstone, wacke, polymictic conglomerate	
		Lower	12 PORTAPIQUE RIVER FM.: red, green siltstone, quartz and lithic wacke	



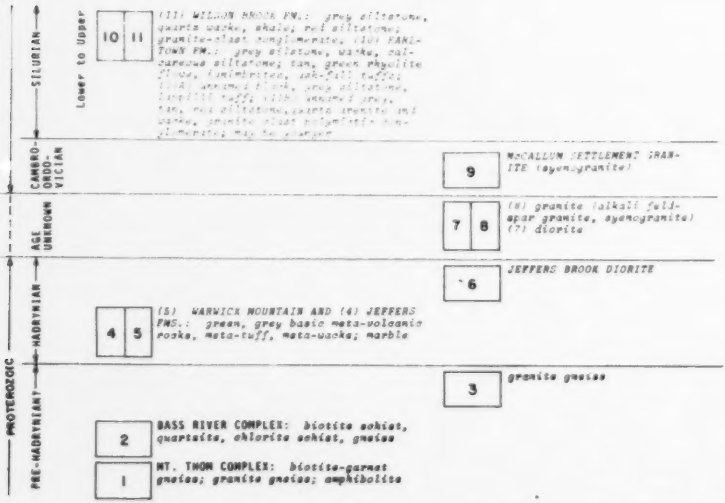

SILURIAN
CAMBRO-ORDOVICIAN
AGE UNKNOWN
HADRYNIAN
PRE-HADRYNIAN
PROTEROZOIC
Lower to Upper
10 11
(11) WILSON BROOK FM.: grey siltstone, quartz wacke, shale, red siltstone; granite-clast conglomerate. (10) PARLTOWN FM.: grey siltstone, wacke, calcareous siltstone; tan, green rhyolite flows, limestone, ash-fall tuffs; (10A) ammonite-bearing, grey siltstone, limestone, ash-fall tuffs with ammonite casts; tan, red siltstone, quartz arenite and wacke, granite clast polymictic conglomerate; may be younger
9
MACALLUM SETTLEMENT GRANITE (syenogranite)
7 8
(8) granite (alkali feldspar granite, syenogranite) (7) diorite
6
JEFFERS BROOK DIORITE
4 5
(5) WARWICK MOUNTAIN AND (4) JEFFERS FMS.: green, grey basic meta-volcanic rocks, meta-tuff, meta-wacke; marble
3
granite gneiss
2
BASS RIVER COMPLEX: biotite schist, quartzite, chlorite schist, gneiss
1
MT. THOM COMPLEX: biotite-garnet gneiss; granite gneiss; amphibolite

Figure 1. Geological map of the Cobequid Highlands.

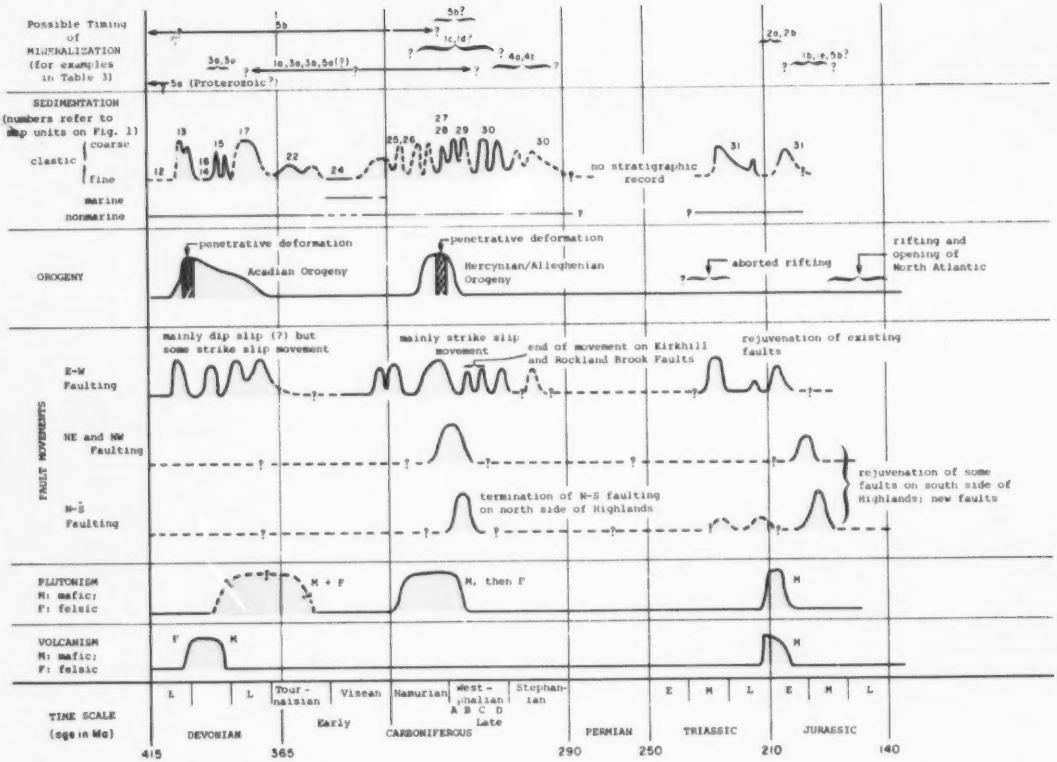


Figure 2. Timing of events in the Cobequid Highlands.

Orogeny because no direct or indirect evidence is available in the Cobequid Highlands. During either the Acadian Orogeny or the later Hercynian-Alleghenian Orogeny Donohoe and Wallace (1980b) suggested that a minimum of 20 km of right lateral displacement took place along the Cobequid Fault. Outcrop patterns suggest movement of greater than 40 km on the Rockland Brook Fault. Movement on this fault ended in "Middle" Carboniferous time after the emplacement of the crosscutting granite of the Pleasant Hills pluton (pluton E on Fig. 1). Vertical movement continued after the main horizontal movement abated. The stratigraphic record for the Permian and Early Triassic is missing, but the first Triassic strata again record new vertical movements during the aborted rifting.

Viewed on a regional scale most of the east-west trending faults are deep faults and represent a major fracture zone in the earth's crust. They have influenced sedimentation since the Devonian; provided a locii for the eruption of Middle Devonian mafic and felsic volcanic rocks; and produced zones of weakness along which some of the plutons have been emplaced. Many of the mineral occurrences are located adjacent to faults thereby suggesting a causative relationship.

Strata of the Cobequid Highlands have been intruded by a relatively large volume of plutonic rocks. Pre-Devonian plutonic rocks are small in volume and are biomodal; dioritic and granitic. Two plutons have been dated; the Jeffers Brook pluton (pluton A on Fig, 1) has a dioritic composition and a Rb/Sr radiometric age of 541±25 Ma (Cormier, 1979); and the McCallum Settlement pluton (pluton B) has a granitic composition and a Rb/Sr age of 504±27 Ma (Cormier, 1980). Approximately 80 per cent of the plutonic rocks in the Highlands are Devonian and younger. Some of these plutons have Carboniferous, Rb/Sr radiometric age dates: Cape Chignecto pluton (pluton C), 339±22 Ma (Cormier, 1979); Hart Lake-Byers Lake pluton (pluton D), 331±27 Ma and 331±17 Ma (Cormier, 1979); and Pleasant Hills pluton (pluton E), 315±25 Ma (Cormier, 1980). The remaining plutons are dated by the minimum age of the host rock.

The Devonian or younger plutonic rocks have a modal composition of diorite to granite. Several large diorite plutons are intruded by the younger granitic plutons. Specifically only one pluton, the Debert River pluton (pluton F), has a granodiorite composition. The other felsic plutons are either monzogranites or syenogranites. The Cape Chignecto and Hart Lake-Byers Lake plutons vary from syenogranite to alkali feldspar granite. The youngest pluton, the Pleasant Hills pluton, is biotite bearing. The Cape Chignecto pluton has virtually no mafic minerals (perhaps chlorite after biotite); the Hart Lake-Byers Lake has hornblende and minor amounts of biotite. The other plutons have small amounts of hornblende and biotite with much alteration to chlorite. The Hart Lake-Byers Lake and Cape Chignecto plutons both have a granophyric texture overprinting the usual hypidiomorphic granular texture of the other granitic plutons. Some parts of the Pleasant Hills pluton have mantled potassium feldspars. Open cavaties are found in exposures of the Hart Lake-Byers Lake pluton on the highest elevations, suggesting that the pluton is a high level pluton. The Cape Chignecto, Hart Lake-Byers Lake and Pleasant Hills plutons are normative corundum poor to normative corundum free (Donohoe *in* Clarke et al., 1980). None of the granitic plutons are mineralized.

MINERAL OCCURRENCES

Classification

Metallic and some non-metallic mineral occurrences have been placed in a descriptive classification. The major divisions (associations) are based on the major rock catergory hosting the occurrence or the type of control or morphology of the mineralization. Each association has been subdivided into a naturally occurring grouping of minerals. This classification has helped organize the numerous occurrences so that their mode of occurrence and constraints on the timing of mineralization can be better understood.

All of the mineral occurrences in the Cobequid Highlands and adjacent areas north and south of the Highlands are listed in Tables 1 and 2. The classification is shown in Table 3. Each grouping is accompanied by a description and a principal example which is representative of the grouping.

Discussion

The history of mineralization in the Cobequid Highlands is graphically portrayed in Figure 2. The probable times of mineralization also coincide with major periods of fault movement (both lateral and vertical) and of mafic and/or felsic intrusive activity. The coarseness of sedimentation reflects the proximity to the source and the local vertical relief probably developed through fault movements. The principal times of significant coarse sedimentation, fault movements and intrusive activity were during the Acadian Orogeny, Hercynian/Alleghenian Orogeny, and aborted rifting (Middle Triassic).

Most of the metallic mineral occurrences found in the Cobequid Highlands and classified on Table 3 are of the vein association type. Magmatic association mineralization is confined to copper and magnetite mineralization of the Triassic-Jurassic basalt. Volcanogenic association mineralization is limited in the number of occurrences, but this may be the result of few discoveries. Mineralization associated with the sedimentary association is confined to the Late Carboniferous aged rocks north and south of the Highlands. Structural association mineralization is limited to only a few locations in the Cobequid Highlands.

Constraints on Timing

On Figure 2 the possible timing of mineralization is shown in relation to episodes of faulting, plutonism, sedimentation, volcanism, and orogeny. Most of the suggested times of mineralization coincide with other major events: the Acadian and Hercynian-Alleghenian Orogeny and the aborted rifting (Triassic time).

Most of the occurrences of barite (1e on Table 3) are associated with north-south trending faults. These faults cut the youngest strata of the Fundy Group (unit 3l on Fig. 1; Triassic-Jurassic) and have the same amount of offset north and south of the Cobequid Fault. Because of the association with these faults the age of mineralization is considered to be post-Early Jurassic. The base metal sulphides-Fe carbonates-barite of the Londonderry area (Grouping 1b on Table 3) are bracketed in age; the carbonate bodies cut the Hercynian-Alleghenian cleavage, but are

Table 1. Metallic mineral occurrences.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M1 (1)	21H07-4	Y	Mn, Fe	Apple River area	Holocene bog deposits	bog manganese in nodules
M2 (1)	21H07-3	Y	Fe, Cu: pyrite, chalcopyrite	Advocate area, McGahey Brook	grey siltstone, wacke beds; Greville River Formation (21)	no data on occurrence
M3 (1) M6 (1)	21H07-2	Y	Cu: native Cu	Cap D'Or	basalt; North Mountain Basalt (31)	fillings of vesicles; found along contacts and in flows
M5 (1)	21H07-1	Y	Cu, Fe: pyrite, chalcopyrite, bornite, native copper	Spencer's Island E-NE of Cap D'Or	basalt; North Mountain Basalt (31)	found on polygonal joints
M6 (1)		Y	Cu, Fe. pyrite, chalcopyrite	north of Advocate on McRitchie Brook	coarse lithic wacke, conglomerate; Rapid Brook Formation (21)	veins of minerals
M7 (2)	21H08-8	N	Au	Glasgow Brook N of Diligent River Village	fault breccia (?) in E-W fault	reported from location in the Kirkhill Fault zone; quartz veins; no assays available
M8 (2)	21H08-15	N	Pb, Cu	S of Jeffers Brook; N of Parrsboro	fault breccia (?)	no data on nature of occurrence; may be associated with N-S trending fault intersecting E-W
M9 (2)	21H08-3	Y	Cu, Fe: pyrite, chalcopyrite	E of Moose River at headwaters of Shipyard Brook	grey siltstone, wackes; unnamed Silurian to Devonian unit (118)	mineralization associated with quartz-amphibole veins trending 115-130°, vertical dips
M10 (2)	21H08-12	N	Fe: specular hematite	W of Harrington River in Boyd Brook	grey siltstone, wacke beds; unnamed Silurian to Devonian unit (118) and Parrsboro Formation (27)	veins associated with faulting

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M11 (2)	21H08-4		Cu, Pb: galena, chalcopyrite	W of North River of Five Islands	grey meta-tuffs, meta-wackes; Jeffers Fm. (4)	no data on occurrence
M12 (2)	21H08-9	Y	Fe: specular hematite	North River of Five Islands	hornblende granite; North River pluton (19)	veins of specular hematite
M13 (2)	21H08-1		Cu, Pb, Zn: pyrite, chalcopyrite, galena, sphalerite	tributary of Shad Brook		location not exact, appears to be mineralized veins in N-S trending fault zone
M14 (2)	21H08-16	Y	Fe, Pb, Zn: pyrite, galena, sphalerite; silver in galena	on road, and trenches to E; N of Five Islands Village and E of North River on Bass River of Five Islands	grey conglomerate, siltstone, wacke; unnamed Silurian to Devonian unit (11B)	in outcrop mineralization follows bedding (fine grained calcareous layers) and cleavage
M15 (2)	21H08-13	Y	Fe: specular hematite	East River of Five Islands	green, grey wacke siltstone; unnamed Silurian to Devonian unit (11B)	veins of specular hematite in clastic rocks probably associated with N-S or NE trending faults
M16 (2)	21H08-2	Y	Cu, Mn	Old Wives Point, W end of Economy Mountain	basalt; North Mountain Basalt (31)	native copper in basalt agglomerate; Mn on polygonal joint faces and fault zones.
M17 (2)	21H08-5	Y	Cu: native Cu	Swan Creek, E of Greenhill	basalt; North Mountain Basalt (31)	patches and flakes in basalt
M18 (2)	21H08-	Y	Mn	small S-flowing brook, W of Wasson's Bluff	siltstone, shale; Blomidon Formation (31)	coatings and thin veins in fine grained clastic rocks in E-W fault zone

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	MTS Map-NSDME Ref. No. (OFR454)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M19 (2)	21H08-7	Y	Cu: native copper	Wasson's Bluff	basalt; North Mountain Basalt (31)	patches and flakes; some filling of vesicles in basalt
M20 (2)	21H08-10	Y	Fe: specular hematite	W of Clarke Head	fault zone; Blomidon Formation (31) and North Mountain Basalt (31)	thin, small veins of specular hematite in Clarke Head Fault zone and in shales of Blomidon Fm. and basalt of North Mountain Basalt
M21 (2)	21H08-11	Y	Fe: specular hematite	Crane Point, W side of Parrsboro Harbour	red, grey siltstones, wackes; West Bay Formation (25)	veins of specular hematite parallel to bedding
M22 (2)	21H08-14	N	Pb: galena (float)	top of Partridge Island	unknown (possibly from M)	float boulder; no data about rock type: may be related to Pb mineralization at M8 and M23
M23 (2)	21H08-6	Y	Cu: chalcopyrite, pyrite; minor galena	Davidson Brook, N of Parrsboro	dark grey hornblende diorite; Davidson Brook pluton (18)	fractures and veins in diorite; may be associated with a N-S trending fault
M24 (2)	11E05-5	Y	Fe: specular hematite	West Branch, Economy River	pale orange, hornblende granite; Pleasant Hills Granite (23)	veins in granite
M25 (3)	11E05-4	Y	Fe: magnetite	E slope, Economy Mt. near Rte 2	basalt; North Mountain Basalt (31)	magmatic segregation, gentle dip toward NW of layer 0.5 to 2 m thick (see Weeks, 1948)
M26 (3)	11E05-22	N	Mn	Lower Economy (east side of Economy Mountain)	grey, red siltsone, wacke; Parrsboro Formation (27)	surface coatings on bedding
M27 (3)	11E05-6	Y	Fe: magnetite, pyrite	Bass River, N of Londonderry Fault and 300 m W of river	quartz feldspar horn-blende gneiss; Great Village River Gneiss of Bass River Complex (2) & siltstones of London-derry Formation (26)	at or in Londonderry Fault zone; fine grained mineralization in fault gauge; mineralized zone very dark grey, nearly E-W trending (see Weeks, 1948)

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M28 (3)	11E05-10	N	Fe: specular hematite	two locations-(N): S-flowing tributary of Portapique River; (S): on Portapique River south of Londonderry Formation	(N): gneiss; Great Village River Gneiss of Bass River Complex (2); (S): dark grey siltstones, wackes; Londonderry Formation (26)	(N): small veins adjacent and parallel to Rockland Brook Fault, post dating S_2 metamorphic foliation; (S): small veins cut beds and Hercynian-Allegheni.an Orogeny cleavage
M29 (3)	11E05-11	N	Pb, Cu: galena, chalcopyrite	S-flowing tributary of Portapique River near Gamble Brook	quartz feldspar hornblende chlorite gneiss; Great Village River Gneiss of Bass River Complex (2)	no data on occurrence
M30 (3)	11E05-2	Y	Cu: chalcopyrite	Copper Brook, E-flowing tributary of Portapique River	grey siltstone wacke; Londonderry Formation (26)	veins, fractures of calcite, quartz, chalcopyrite, pyrite trending 070/80S
M31 (3)	11E05-10	N	Fe, Cu, Pb: pyrite, hematite, chalcopyrite, galena	Portapique River, 40 m S of Londonderry Fault, E side	green grey siltstone wacke, Londonderry Formation (26)	mineralization found in veins; no further data
M32 (3)	11E05-9	Y	Fe: ankerite	Matheson Brook	green, grey siltstone, wackes; Londonderry Formation (26)	veins, pods of ankerite cutting bedding and Hercynian-Allegheni.an Orogeny cleavage (see Weeks, 1948)
M33A (3)	11E05-7	Y	Fe, Ba: barite, ankerite, siderite goethite, limonite, specular hematite	Cumberland (Spencer) Brook (West Mines)	green siltstone, wacke of Londonderry Formation (26)	veins, stringers, elongate bodies of iron carbonate and oxides cut bedding and cleavage; barite and calcite found as float; small fragments of Londonderry Formation in carbonate; general east-west trend (see Weeks, 1948)

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M33B		Y	Ank: ankerite, siderite, goethite, limonite, specular hematite	Martins Brook (West Mines)	green siltstone, wacke; Londonderry Formation (26)	no barite found here; mineralogy and field relationships are the same M33A (see Weeks, 1948)
M33C		Y	Ank: ankerite, siderite, limonite, goethite, specular hematite	Old Mountain Mine; W of Great Village River	green siltstone, wacke; Londonderry Formation (26)	large ankerite quarry (60 x 40 x 10 m); veins and pods of geothite, limonite, siderite; veins of specular hematite; all veins, lodes cut Hercynian-Alleghenian Orogeny cleavage; mineralized areas oriented E-W, offset by N-S fault (see Weeks, 1948)
M33D		Y	Ank, Cu: calcite, pyrite, ankerite, siderite, chalcopyrite	Rockland Brook, 800 m S of Londonderry Fault	green siltstone, wacke; Londonderry Formation (26)	veins throughout a 10 m section of rock; mineralogy of calcite ± ankerite ± pyrite ± specular hematite ± siderite ± chalcopyrite ± quartz; open vugs with euhedral quartz crystals; all cut Hercynian-Alleghenian Orogeny cleavage (see Weeks, 1948)
M33E		Y	Ank: ankerite, siderite	East Mines, E of Folly River	green siltstone, wacke; Londonderry Formation (26)	large lodes of ankerite, veins of siderite, calcite, specular hematite; all cut Hercynian-Alleghenian Orogeny cleavage; some of carbonate lodes are in E-W fault zone (see Weeks, 1948)
M34 (3)	11E05-8	Y	Ank, Fe: hematite, pyrite, barite, siderite, ankerite, calcite, hematite,	Derry Prospect, N of Londonderry, E flowing tributary of Great Village	green siltstone, wacke; Londonderry Formation (26)	hematite, limonite, goethite lode and adjacent to Rockland Brook Fault; small veins of calcite, siderite, ankerite, specular hematite; lodes, veins of calcite, barite, ankerite, siderite; all of these cut bedding and Hercynian-Alleghenian Orogeny cleavage (see Weeks, 1948)

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDNE Ref. No. (OFR454)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M35 (3)	11E05-1	Y	Cu, Fe: pyrite, ankerite, calcite, chalcopyrite	CNR mainline E of TCH (Rte 104) and in Folly River	grey, green wackes, siltstones; Londonderry Formation (26)	veins, pods of calcite, siderite, ankerite, chalcopyrite, pyrite oriented generally E-W
M36 (3)	11E12-14	Y	Th, Y, La, Ce, Y, Ag	200 m W of Simpson Lake	tan to grey rhyolite; Fountain Lake Group (16)	no data on occurrence
M37 (3)	11E12-10	N	Fe: specular hematite	Chain Lakes Brook	tan to grey rhyolite; Fountain Lake Group (16)	veins of specular hematite
M38 (3)	11E12-3	Y	Cu, Zn, Pb: pyrite, chalcopyrite; high geochemical soil anomalies	S flowing tributary of Sugarloaf Brook		stream geochemistry indicate Cu anomalies on Sugarloaf Brook and to west on a tributary of River Phillip; no other data
M39 (3)	11E12-1	Y	Cu, As, Au: pyrite, arsenopyrite, gold in sulphides (?), carbonate	N flowing tributary of River Phillip; S of Williamsdale	dark grey siltstone, shales, tuff; diabase dykes; Wilson Brook Formation (11)	mineralization associated with E-W (?) crush zones and mafic intrusions; minerals are found in veins and lenses of quartz with calcite and on fracture surfaces; assays indicate 0.02 to 0.56 oz/ton Au
M40 (3)	11E12-13	Y	Pb, Y, La, Ce, Y, Ag	Folly Lake, E side; float	boulder of tan rhyolite; Byers Brook Formation (14)	no data on occurrence
M41 (3)	11E12-2	Y	Cu: chalcopyrite , pyrite, malachite	East Wallace River at bridge for New Annan Rd.	grey siltstone, wacke; Boss Point Formation (28)	minerals parallel to bedding

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M42 (3)	11E12-6	Y	Cu: chalcopyrite, malachite, chalcocite	confluence of Palmer Brook and West Wallace River (Palmer Mine)	grey siltstone, wacke; Pictou Group (30)	parallel to bedding in grey shale unit
M43 (3)	11E12-12	Y	Mn	Jersey Bog	Holocene bog	bog Mn, Fe
M44 (3)	11E12-11	Y	Mn	Rose Bog	Holocene bog	bog Mn, Fe
M45 (3)	11E11W	Y	Cu: chalcopyrite,	East Wallace River	tan rhyolite; Byers Brook Formation (14)	disseminated pyrite and chalcopyrite parallel to flow layering
M46 (4)	11E11-20	Y	V, Th, F	S of Annandale on N flowing tributary of Donaldson Brook	tan rhyolite; Byers Brook Formation (14)	no data on occurrence
M47 (4)	11E11-16	Y	Fe, Cu, Au (?): pyrite chalcopyrite, native Au (?)	Byers Brook, pyrite showing W of Byers Lake Road	tan rhyolite and dark brown basalt; Byers Brook (14) and Diamond Brook Formations (15)	zones of pyrite with small amounts of chalcopyrite reported in tan rhyolite, parallel to flow layering; no evidence of Au in outcrop; no assays available
M48 (4)	11E11-18	Y	Fe	Debert River at Rockland Brook Fault	Holocene deposit	bog iron; no further data
M49 (4)	11E11E	Y	Cu, Fe, Pb: pyrite, galena chalcopyrite	Bailey Brook, 1 km S of The Falls Road	tan rhyolite; Fountain Lake Group (16)	tension fractures of quartz plus minerals associated with shear zones oriented 100/80S
M50 (4)	11E11-9	Y	U, Cu: chalcopyrite, malachite	Balfran, Waugh River	sandstone; Pictou Group (30)	parallel to bedding

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M51 (4)	11E11-24	Y	U	Yellow Brook confluence with Waugh River	sandstone; Pictou Group (30)	mineralization is restricted to tabular pods and lenses of a chemically reduced nature surrounding carbonaceous matter
M52 (4)	11E11-10	Y	Cu, Fe: malachite limonite, pyrite, chalcopyrite	Balmoral Brook at confluence with Waugh River	sandstone; Pictou Group (30)	Cu in thin layers of coal and carbonaceous material over 1 to 2 m of section
M53 (4)	11E11-12	Y	Cu: chalcopyrite, pyrite	Oliver North on French River	sandstone; Pictou Group (30)	mineralization associated with carbonaceous matter in sandstone
M54 (4)	11E11-2	Y	Cu: chalcopyrite, pyrite	Oliver on French River	conglomerate, sandstone; Pictou Group (30)	nodules of chalcopyrite and pyrite around carbonaceous matter; malachite staining
M55 (4)	11E11-1	Y	V, Cu: chalcopyrite, pyrite	Oliver South Miller Brook	arkosic conglomerate; Pictou Group (30)	pyrite and chalcopyrite surround carbonaceous matter; malachite staining
M56 (4)	11E11-17	Y	Fe: pyrite	West New Annan	basalt; Diamond Brook Formation (15)	shear zone striking SW filled by massive pyrite
M57 (4)	11E11-13	Y	Cu: chalcopyrite, malachite	Donaldson Mill Brook	grey sandstone; facies a, Cumberland Group (29)	no data on occurrence
M58 (4)	11E11-8	Y	Cu, U: chalcopyrite, malachite pyrite	Black River	sandstone; Pictou Group (30)	mineralization associated with carbonaceous remains

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M59 (4)	11E11-14	Y	Cu: malachite, chalcopyrite, pyrite	Yellow River	grey sandstone; Pictou Group (30)	"pyrite nodules replaced by chalcopyrite"
M60 (4)	11E10-4	Y	Cu: chalcopyrite, malachite	Scotsburn Brook; 2 km W of Scotsburn	sandstone; Falls Formation (17)	"band of sandstone 1.5 m thick, contains some chalcocite and malachite associated with lignite"
M61 (4)	11E10-6	Y	Cu: chalcocite	Plainfield Brook; tributary of East Branch River John	sandstone; Diamond Brook Formation (16)	"nodules of chalcocite in association with lignite in sandstone"
M62 (4)	11E10-3	Y	Cu: chalcopyrite, pyrite	Six Mile Brook	grey, green felsic volcanic rocks; Earltown Formation (10)	quartz veins mineralized; associated with NE trending fault between Earltown Formation and Millsville Conglomerate
M63 (4)	11E06-6	Y	Fe: ankerite, siderite, limonite	Weatherbee and Pine Brooks	grey, green siltstone wackes; Londonderry Formation (26)	large body of ankerite altered to limonite 20 m wide; cuts Hercynian-Alleghenian Orogeny cleavage; has east-west trend (see Weeks, 1948)
M64 (4)	11E06-7	Y	Fe: ankerite, limonite, siderite	Totten Brook	grey, green siltstone wackes; Londonderry Formation (26)	veins and pods; cuts Hercynian-Alleghenian Orogeny cleavage; has east-west trend (see Weeks, 1948)
M65 (4)	11E06-12	N	Fe: specular hematite (?)	Whidden Brook; N of Onslow Mountain	grey siltstones and wackes; Parrsboro Formation (27)	no data on occurrence
M66 (4)	11E06-15	Y	Mn, Fe: pyrolusite, hematite	Farnham Brook; N of Truro	sandstone; Horton Group (22)	pyrolusite is found in joint planes or as replacement of limestone near contact of sandstone with Pembroke limestone (see Stevenson, 1958)
M67 (4)	11E06-21	Y	Mn: pyrolusite	Telegraph Road	red sandstone, siltstone; Horton Group (22)	no data on occurrence

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M68 (4)	11E06-16	Y	Mn: pyrolusite	East Mountain Mine; NE of Truro	contact of sandstones of Horton Group (22) & limestones of Windsor Group (24)	on joint planes or as replacement of limestone at or near contact of Horton Group sandstone (see Stevenson, 1958)
M69 (4)	11E06-17	Y	Mn: pyrolusite	Manganese Mines; NE of Truro	sandstone; Horton Group (22)	along joint planes and bedding planes (see Stevenson, 1958)
M70 (4)	11E06-18	Y	Mn, Fe: pyrolusite, limonite, hematite, siderite, pyrite	Borden Property	sandstone; Horton Group (22)	in veinlets, along joints and bedding planes (see Stevenson, 1958)
M71 (4)	11E06-10	Y	Fe:	Mackenzie Brook; NE of Truro	sandstone; Horton Group (22)	no data on occurrence
M72 (4)	11E06-2	Y	Cu: pyrite, chalcopyrite, bornite	Salmon and Black Rivers; NE of Truro	sandstone; Parrsboro Formation (27)	secondary replacement in cross-fractures and joints, disseminated
M73 (4)	11E06-22	Y	Mn: pyrolusite (?)	North River	sandstone; Parrsboro Formation (27)	"float and veins"
M74 (4)	11E06-8	Y	Fe: hematite limonite, goethite, specular hematite	Upper Kemptown, on road to Earltown	sandstone; Canso Group (25)	narrow stringers, fractures and lenses
M75 (4)	11E06-1	Y	Cu, Fe: chalcopyrite, pyrite, ankerite, hematite, sphalerite	Mt. Thom; NE of Kemptown on Steele Run	grey, green siltstone, wacke; Canso Group (25)	Cu mineralization in ankerite breccia zone, in fractures adjacent to and in NW trending fault zone

Table 1. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR454)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
M76 (4)	11E07-13	N	Fe	Calvary Stream; E of Truro	sandstone; Horton Group (22)	near fault zone, E-W (Riversdale Fault) and NE trending; no other information
M77 (4)	11E07-15	N	Fe	New Gairloch	sandstones; Canso Group (25)	no data on occurrence
M78 (4)	11E05	Y	Pb, Zn: galena, sphalerite	Londonderry, drillholes near Saltspring Brook; Great Village River	grey feldspathic and quartz wacke; Pictou Group (30)	galena and fine grained sphalerite in layers parallel to bedding which has most feldspar; mineralization takes form of fine laminations;
M79 (4)	11E05	Y	Cu: chalcopyrite, malachite	Folly River south of Cobequid Fault	grey and red wackes; Pictou Group (30)	mineralization parallel to bedding in areas of most carbonaceous material
M80 (2)	21H08	Y	Cu, Pb: chalcopyrite, pyrite, galena	East Parrsboro, between Gavin Brook and Shipyard Brook	rhyolites; Fountain Lake Group (16) and granite; West Moose River pluton (19)	veins and fracture fillings in rhyolite, granite; close association with east-west faults (Cobequid Fault)

Table 2. Non-metallic mineral/commodity occurrences.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR431)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-1 (1)		Y	carbonate old quarry	Brookville	unnamed limestone, and calcareous arenite in Cobequid Fault Zone	crudely bedded; much sandstone; poorly preserved brachiopods found
N-2 (1)		Y	coal	De Wolf Brook	grey wacke; Cumberland Group, facies b (29)	thin shaly layers of coal, 4 to 12 m thick
N-3 (1)	21H07-1	Y	barite, minor fluorite, calcite	Spicer Cove	tan red rhyolite, red brown conglomerate, grey sandstone, rhyolite; Fountain Lake Group (16) and Cumberland Group, faces a, b, (29)	veins trend 055/75 NW; 090/80S, & N; 140/80SW; (see Felderhof, 1978)
N-4 (1)		Y	coal	Spicer Cove	grey sandstone, shale; Cumberland Group, facies b (29)	thin coal seams, 4 to 12 cm thick
N-5 (1)		Y	gypsum	West Advocate Beach	Cobequid Fault Zone	found in fault gouge produced during deformation of Greville River Formation (21) and Wolfville Formation (31)
N-6 (1)	21H07-2	Y	clay	West Advocate Beach	Pleistocene, marine clay	
N-7 (1)	21H07-4	Y	clay	East Advocate	Pleistocene, marine clay	
N-7 (1)	21H07-5	Y	gemstone jasper	Horseshoe Cove, Cap D'Or	basalt; North Mountain Basalt (31)	found in vugs and amygdules
N-9 (1)	21H07-7	Y	shale	south of Spencer's Island village	siltstone, sandstone; Wolfville Formation (31) & Holocene deposits	no data on occurrence

Table 2. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR431)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-10 (1)	21H07-8	Y	shale (?)	Fox River mouth	grey, tan siltstone, sandstone; Parrsboro Formation (27)	no data on occurrence
N-11 (2)	21H08-15	Y	limestone	Kirkhill (abandoned quarry); Clarke Head	grey, thinly bedded limestone; Windsor Group (24)	no bedrock exposed
N-12 (2)		Y	gypsum	Clarke Head (southeast of Parraboro)	gypsum veins in fault gauge; Clarke Head Fault zone	
N-13	21H08-1	Y	barite	NE of Parraboro	grey siltstones; Greville River Formation (21)	found in brecciated zones as cement also filling veins, oriented 145/75 NE; specially close to N-S; (see Felderhof, 1978)
N-14 (2)	21H08-2	Y	barite	Lynn Road	grey siltstones; unnamed Silurian to Devonian unit (118)	veins, pods, brecciated zones; no alteration noted; intersected in many drillholes to east; specially close to N-S trending fault; (see Felderhof, 1978)
N-15 (2)	21H08-4	Y	barite, minor fluorite	Eureka Mine, Bass River of Five Islands, W side of river	grey, blue-grey siltstone, sandstone; unnamed Silurian to Devonian unit (118)	generally appears to be fault controlled (NE-SW trend); some veins on east side oriented 105/50NE, 120/90, 130/80 NE; in mine veins have a general northerly trend; (see Felderhof, 1978)
N-16 (2)	21H08-3	Y	barite, fluorite, calcite, pyrite, chlorite, specularite	East River of Five Islands	grey and black siltstone, pale red arkose; unnamed Silurian to Devonian unit (118)	fills in brecciated zones associated with E-W trending faults and possible N-S trending faults; (see Felderhof, 1978)
N-17 (2)		Y	marble	North River, west bank	grey to white grey marble & impure marble; Jeffers Formation (4)	large blocks on west bank and in river

Table 2. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR431)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-18 (2)	21H08E	N	asbestos	Harrington River; SW flowing tributary of Boyd Brook	green to grey basic meta-volcanic rocks; Jeffers formation (4)	located in general proximity to N-S and E-W trending faults; reported by Fletcher (1905)
N-19 (2)	21H09-1	Y	barite	South Brook	grey sandstone; Cumberland Group, facies b (29)	associated with breccia zones
N-20 (2)	21H08-5	Y	clay, shale	Parrsboro River side	grey siltstone, sandstone; Parrsboro Formation (27) and Pleistocene deposits	no data on occurrence
N-21 (2)	21H08-6	Y	clay	Riverside Beach, McLaughlin Bluff	Pleistocene deposits	no data on occurrence
N-22 (2)	21H08-7	Y	clay	W of Black Rock	Pleistocene deposits	no data on occurrence
N-23 (2)	21H08-8	Y	gems (agate)	N island of Two Islands	basalt flows; North Mountain Basalt (31)	segregations in basalt
N-24	21H08-9	Y	gems (agate)	S side, Moose Island	basalt flows; North Mountain Basalt (31)	segregations in basalt
N-25 (2)	21H08-10	Y	gemstones (amethyst)	Partridge Island	basalt flows; North Mountain Basalt (31)	chalcedony in large segregations in basalt
N-26 (2)	21H08-12	Y	gem stones (amethyst, zeolite)	Cape Sharp	basalt flows; North Mountain Basalt (31)	amethyst and chalcedony; zeolites in segregations in basalt
N-27 (2)	21H08-13	Y	graphite	Partridge Islands	basalt flows; North Mountain Basalt (31)	occurs in shear zones

Table 2. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR431)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-28 (2)	21H08-14	Y	gypsum	Clarke Head (SE of Parrsboro)	Clarke Head Fault zone (unit FZ-CH on Sheet 2)	veins and stringers of gypsum in gouge; large blocks of red clastic rocks and limestone cut by gypsum
N-29	21H08-17	Y	clay/shale	Partridge Island area	Pleistocene sediments; Wolfville Formation (31) and West Bay Formation (25)	some Pleistocene marine clay in exposures; mostly shale and siltstone from other formation
N-30 (2)	21H08-18	Y	shale	Diligent River	Parrsboro Formation (27)	no data on occurrence
N-31 (3)	21H08-19	Y	shale	west of Diligent River mouth	grey siltstone, sandstone; Parrsboro Formation (27)	no data on occurrence
N-32 (3)	11E05-2	Y	barite	Bass River	sandstone, siltstone; of Londonderry Formation (26) and Parrsboro Formation (27)	crystalline masses and lenses within Londonderry Fault zone; area of occurrence cut by numerous N-S faults; (see Felderhof, 1978)
N-33 (3)	11E05-3	Y	barite, siderite and ankerite	Rockland Brook south of Cobequid Fault	red brown sandstone; Parrsboro Formation (27)	small veinlets of barite and minor amounts of siderite and ankerite; E-W trend; (see Felderhof, 1978)
N-34 (3)	11E05W	Y	barite, ankerite, siderite, (Derry Prospect)	Great Village River, east flowing brook at Londonderry Fault	green, grey siltstone, wacke; Londonderry Formation (26)	veins of barite, ankerite and siderite parallel to and crosscutting bedding and Hercynian-Alleghenian Orogeny cleavage; (see Felderhof, 1978)
N-35 (3)	11E05-12	Y	limestone	Lornevale, in Cobequid Fault zone	limestone in fault zone	abandonded limestone quarry; tan, white, grey layered limestones
N-36 (3)	11E05-11	Y	limestone	Upper Economy	Windsor Group (24)	thinly bedded, dark grey, dense fossiliferous limestone

Table 2. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR431)	Confirmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-37 (3)	11E05-4	Y	clay	Little Bass River	Pleistocene marine clay	no data
N-38 (3)	11E05-5	Y	diatomite	Economy Lake	Recent deposit	"small deposit but good quality"
N-39 (3)	11E05-6	Y	diatomite	Gamble Lake	Recent deposit	"2 to 3 feet of pure white diatomite at edge of lake and near cranberry marsh"
N-40 (3)	11E05-7	N	diatomite	Little Bass River	Recent deposit	no data on occurrence
N-41 (3)	11E05-8	N	graphite	Bass River	fault	probably found in faults, E-W trending
N-42 (3)	11E05-18	Y	silica (chalcedony)	Economy Mountain	basalt; North Mountain Basalt (31)	chalcedony segregations in basalt
N-43 (4)	11E05	Y	coal	Debert Mine north of Debert	sandstone, conglomerate, siltstone; Pictou Group (30)	six seams of coal ranging in thickness from 0.2 to 2 m are present in subsurface; (see Stevenson, 1958)
N-44 (4)	11E05	Y	coal	Staples Brook	siltstone, sandstone; Pictou Group (30)	no data on occurrence; (see Stevenson, 1958)
N-45 (4)	11E05	Y	coal	Coal Mine Brook	siltstones, sandstones; Pictou Group (30)	two seams, 0.2 and 0.4 m thick; (see Stevenson, 1958)
N-46 (4)	11E06	Y	coal	West North River	grey siltstones; Pictou Group (30)	no data on occurrence; (see Stevenson, 1958)
N-47 (4)	11E	Y	coal	Kemptown Mine at Kemptown	grey siltstones and sandstones; Pictou Group (30)	coal seam 0.5 to 1.2 m thick; (see Stevenson, 1958)

Table 2. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR431)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-48 (4)	11E	Y	coal	Riversdale	grey sandstones, shales; Pictou Group (29)	no data on occurrence; (see Stevenson, 1958)
N-49 (4)	11E06-9	Y	limestone	Manganese Mines	limestone; Windsor Group (24)	fine grained, light brown in colour, 93.7% $CaCO_3$; (see Stevenson, 1958)
N-50	11E06-4	Y	diatomite	Steele Run, near Pictou County line	Holocene deposit	no data
N-51 (4)	11E06-8	Y	limestone	Penny Mountain, north of Truro	limestone; Windsor Group (24)	"dark grey, hard, laminated, fossiliferous slightly siliceous limestone"
N-52 (4)	11E06-22	Y	silica (sand)	Debert	glacial outwash	"moulding sand"
N-53 (4)	11E06-23	Y	silica (sand)	Belmont	glacial outwash	no data
N-54 (4)	11E11-2	N	clay	Central New Annan	glacial till and/or weathering; Boss Point Formation (28)	no data
N-55 (4)	11E11-3	N	clay	Cavanaugh Brook	Holocene deposit	"red-brown, good workability, some pebbles and organic matter"
N-56 (4)	11E11-4	N	clay	Chain Lakes	Holocene deposit	no data
N-57 (4)	11E11-5	Y	diatomite	Gard Lake	Holocene deposit	"8 ft. of dark to light cinnamon coloured diatomite"
N-58 (4)	11E11-6	Y	diatomite	Farm Lake	Holocene deposit	"small and pockety"

Table 2. Continued.

Occurrence Number (Sheet No. on OFR455)	NTS Map-NSDME Ref. No. (OFR431)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-59 (4)	11E11-7	Y	diatomite	Indian Lake	Holocene deposit	"small deposit of poor quality"
N-60 (4)	11E11-8	Y	diatomite	MacIntosh Lake	Holocene deposit	no data
N-61 (4)	11E11-9	Y	diatomite	Snare Lake	Holocene deposit	"large deposit but shallow and impure"
N-62 (4)	11E11-10	Y	diatomite	Earltown Lake	Holocene deposit	"2 ft. of hard white and locally up to 12 ft. of darker and softer diatomite in various pockets over lake bottom"
N-63 (4)	11E11-11	Y	diatomite	Little Lake	Holocene deposit	"12 acre lake containing an average of 2.5 ft. of low grade diatomite"
N-64 (4)	11E11-12	Y	diatomite	Gully Lake	Holocene deposit	no data
N-65 (4)	11E11-13	Y	diatomite	Stillwater Bog	Holocene deposit	"cinnamon brown to black diatomite"
N-66 (4)	11E11-14	Y	diatomite	Trout Lake	Holocene deposit	"white and grey diatomite, in places 12 ft. deep"
N-67 (4)	11E11-16	Y	diatomite	Lockerby Pond	Holocene deposit	"2 acres, average depth of 8 ft.of cinnamon coloured to very dark brown diatomite"
N-68 (4)	11E11-17	Y	diatomite	Clear Lake	Holocene deposit	"varying thickness of diatomite"
N-69 (4)	11E11-18	Y	diatomite	Debert Lake	Holocene deposit	"several feet of good diatomite at northend"
N-70 (4)	11E11-19	Y	diatomite	Conkey Pond	Holocene deposit	"0.5 acre, 2-3 ft. of pure white diatomite"

Table 2. Continued.

Occurrence Number (Sheet No. on OFR455	NTS Map-NSDME Ref. No. (OFR431)	Con-firmed	Commodity: Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-71 (4)	11E11-20	Y	diatomite	Whippey Lake	Holocene deposit	"white to grey material, lying beneath maximum depth of 6 ft. of water"
N-72 (4)	11E11-21	Y	diatomite	Rhude Pont	Holocene deposit	"3 to 16 ft. of diatomite, top 2 ft. are cinnamon brown"
N-73 (4)	11E11-22	Y	diatomite	Black Lake	Holocene deposit	"small deposit, but good quality, cinnamon brown coloured"
N-74 (4)	11E11-23	Y	diatomite	Chain Lakes	Holocene deposit	"quantity large but grade low"
N-75 (4)	11E11-24	Y	diatomite	Irving Lake	Holocene deposit	"2 to 6 ft. of fair grade diatomite"
N-76 (4)	11E11	Y	diatomite	Clear Lake bog	Holocene deposit	no data on occurrence
N-77 (4)	11E11	Y	crushed rock	Old Truro Road	basalt; Diamond Brook Formation (15)	massive basalt veined by calcite
N-78 (4)	11E12-1	Y	barite	North Greenville	conglomerate; Cumberland Group (29)	aggregates of well developed smoky to transparent crystals; (see Felderhof, 1978)
N-79 (4)	11E12-2	Y	clay	Windham Hill (SW of Collingwood Corner)	Holocene deposit	blue-grey kaolin
N-80 (4)	11E12-3	Y	diatomite	Lily Pond	Holocene deposit	"4 ft. depth over 4 acres"
N-81 (4)	11E12-4	Y	diatomite	Newfound and Issac Lakes	Holocene deposit	"small and low grade"

Table 2. Continued.

Occurrence Number (Sheet No. on OFR455	NTS Map-NSDME Ref. No. (OFR431)	Con-firmed	Commodity; Mineralogy	General Location	Host Rock; Formation, Unit (Map unit on Fig. 1)	Characteristics
N-82 (4)	11E12-5	Y	diatomite	Moose Lake	Holocene deposit	"2-3 ft. of hard and dense diatomite over 6 acres"
N-83 (4)	11E12-6	Y	diatomite	Hart Lake	Holocene deposit	"small, shallow, impure deposit"
N-84 (4)	11E12-7	Y	diatomite	British Lake	Holocene deposit	"small, low grade"
N-85 (4)	11E12-8	Y	diatomite	Folly Lake	Holocene deposit	"1 to 7 ft. dense white diatomite at south end of lake"
N-86 (4)	11E12-9	Y	diatomite	Base River Lake	Holocene deposit	no data on occurrence
N-87 (4)	11E12-10	Y	diatomite	Fountain Lake	Holocene deposit	"considerable quantity of high grade diatomite in south end"
N-88 (4)	11E12-11	Y	diatomite	West Branch Lake	Holocene deposit	"small shallow deposit of low grade"
N-89 (4)	11E12-12	Y	diatomite	Webb Lake	Holocene deposit	"deposits at east end of lake, 1 to 3 ft. thickness"
N-90 (4)	11E12-13	Y	diatomite	Sutherland Lake	Holocene deposit	"very pockety and low grade"
N-91 (4)	11E12-14	Y	diatomite	Slack Lake	Holocene deposit	"6 to 7 ft. of dark brown diatomaceous mud; centre has 1 ft. of good white diatomite"
N-92 (4)	11E12-15	Y	diatomite	Simpson Lake	Holocene deposit	"small and low grade"
N-93 (4)	11E12-16	Y	diatomite	Otter Lake	Holocene deposit	"low grade; south end of lake has diatomaceous mud"
N-94 (4)	11E12	Y	rock	Folly Lake	quartzite; Gamble Brook Schist, part of Base River Complex (2)	white to grey quartzite, near vertical metamorphic foliation; undeformed diabase dykes cut the quartzite

Table 3. Associations and groupings of mineral occurrences in the Cobequid Highlands region.

ASSOCIATION/ Grouping	Characteristics of Grouping	Principal Example			
		Name (No. on Tables 1,2) (NSDME Assessment, occurrence no.); Location	Host Rock(s) (Age of Host Rock; Map Unit From Fig. 1)	Characteristics	Constraints on Timing of Mineralization (cf. Fig. 2)
1. VEIN					
a) base metal (Cu, Pb), pyrite-quartz	discordant to bedding and cleavage of host; generally mineralization near or in fault zones; no preferred host lithotype	East Parrsboro (M80) (07-E-11(03), (21H08-3)) between Parrsboro and Five Islands	siltstone of unnamed (Silurian-Devonian; 11B) rhyolite of Fountain Lake Group (Middle to Late Devonian; 16) granite of west Moose River pluton (Devonian-Carboniferous; 19) siltstone of Parrsboro Formation (Late Carboniferous; 27) all along Cobequid Fault	two modes of occurrence: 1) in Cobequid Fault zone, small veins (2 - 6 cm wide) of quartz ± calcite ± pyrite, some calcite veins with fluorite; 2) in massive or homogeneous granite; roof pendants of unnamed Silurian-Devonian; and rhyolite veins up to 5 m long, 30 cm wide, most veins are small (4 to 12 cm wide); mineralogy is quartz ± pyrite ± chalcopyrite ± galena.	mineralization postdates granite and/or postdates last (?) movement on Cobequid Fault
b) base metal sulphides (Cu-Pb-Zn); Ca, Fe carbonates - barite	discordant and concordent to bedding and cleavage; spacially located near major faults; not associated with volcanic rocks, no surface exposure of major intrusive igneous bodies	Londonderry District (M33) (11E05-7); Portapique River east to Debert River, south side of Highlands	green, grey siltstone, wacke of Londonderry Formation (Carboniferous; 26)	numerous veins, small and large elongate bodies of Ca, Mg, Fe carbonates (ankerite, siderite, calcite); the small and large bodies composed of ankerite and siderite; some bodies are capped by hematite and limonite; some veins of calcite and ankerite have barite; other veins contain calcite ± quartz ± galena ± sphalerite ± chalcopyrite ± pyrite; float shows ankerite ± galena ± sphalerite; specular hematite veins are youngest; carbonate bodies associated with and brecciated by east-west faults; bodies displaced by north-south faults	mineralization postdates Hercynian-Alleghenian cleavage of early Late Carboniferous age; predates north-south trending faults of probable post Early Jurassic age

Table 3. Continued.

ASSOCIATION/ Grouping	Characteristics of Grouping	Principal Example			
		Name (No. on Tables 1,2) (NSDME Assessment, occurrence no.); Location	Host Rock(s) (Age of Host Rock; Map Unit From Fig. 1)	Characteristics	Constraints on Timing of Mineralization (cf. Fig. 2)
c) Fe, Mn oxides	Hematite, pyrolusite and/or manganite in two modes of occurrence: 1) mineralization on bedding or joint surfaces; 2) fracture fillings with or without spacial relation to faults	Portapique River (M28) (11E05-10); intersection of Londonderry and Rockland Brook Faults with river	Londonderry Formation; (Carboniferous; 26) fault zones of each fault	veins 6 to 15 cm wide of specular hematite or pyrolusite; oriented east-west; veins cut Hercynian-Alleghenian cleavage	movement on Rockland Brook Fault ended in early Late Carboniferous time; mineralization postdates Hercynian-Alleghenian cleavage and is probably associated with fault movement
d) Fe, As sulphides; gold (in sulphides)	veins (2 to 20 cm wide) discordant to bedding and cleavage; associated with faulting	Williamsdale (M39) (11E12-1); southeast of Collingwood Corner on north slope of Highlands	Wilson Brook Formation (Silurian; 11)	veins of pyrite ± arsenopyrite ± quartz ± calcite; found in or near east-west faults; gold in sulphides; maximum gold assay value from assessment report 0.5 ozs/ton; veins and faults cut bedding folded by Acadian Orogeny (Middle Devonian)	timing of east-west trending faults Middle Devonian or younger
e) barite	veins and mineralized fault gouge associated with east-west and northerly trending faults	Eureka Mine (N15) (21H08-4); west bank Bass River of Five Islands	siltstones, wackes, shales of undivided (Silurian-Devonian; 11B)	veins of barite ± fluorite ± pyrite 0.5 to 2 m thick with northerly strikes; veins parallel to or occupy fault zones with north-south or north-northeast trends; Acadian Orogeny cleavage cut by veins and faults;	mineralization postdates Acadian Orogeny; it may be synchronous with northerly trending faults which are Early Jurassic age or younger

Table 3. Continued.

ASSOCIATION/ Grouping	Characteristics of Grouping	Principal Example			
		Name (No. on Tables 1,2) (NSDME Assessment, occurrence no); Location	Host Rock(s) (Age of Host Rock; Map Unit From Fig. 1)	Characteristics	Constraints on Timing of Mineralization (cf. Fig. 2)
2. MAGMATIC a) magnetite	magnetite in basalt flows/sills	Economy (Gerrish) Mountain (M25) (11E05-4); eastern end of Mountain	basalt of the North Mountain Basalt (Late Triassic-Early Jurassic; 31)	segregation of magnetite, 1 to 3 m thick at base of first flow or sill	crystallization of basalt is Late Triassic to Early Jurassic
b) native copper	native copper in basalt flows/sills	Cap D'Or (M3) (21H07-2); southeast of Advocate Harbour	basalt of the North Mountain Basalt (Late Triassic-Early Jurassic; 31)	native copper in small stringers (2 to 6 cm long) in basalt flows or sills; azurite and malachite found as alteration products	crystallization of basalt is Late Triassic to Early Jurassic
3.VOLCANOGENIC a) uranium	localized as strata-bound occurrences in felsic volcanic rocks	Folly Lake (M40) (11E12-13); boulder on east side of Folly Lake	Byers Brook Formation, rhyolitic ignimbrites (Middle Devonian; 14)	various uranium and thorium minerals in flow-layered rhyolite; in outcrops mineralization is localized in fractures; diabase and/or diorite intrusions sometimes associated with mineralization	age of volcanic rocks is Middle to Late Devonian; this age if mineralization resulted from volcanic activity; if mineralization is younger then probable upper limit is Late Carboniferous
b) Fe, Cu sulphides (Au ?)	stratiform (?) pyrite, chalcopyrite in felsic volcanic rocks	Byers Brook pyrite (M47) (11E11-16); southeast of Wentworth on north side of Highlands	Byers Brook Formation, rhyolitic flows, ignimbrites, interbedded with tuffs (Middle Devonian; 14)	pyrite and some chalcopyrite disseminated parallel to layering and bedding; gold reported but not found in hand specimen or shown by assays	age of volcanic rocks forms lower limit for age of mineralization; upper limit not known

Table 3. Continued.

ASSOCIATION/ Grouping	Characteristics of Grouping	Principal Example			
		Name (No. on Tables 1,2) (NSDME Assessment, occurrence no.); Location	Host Rock(s) (Age of Host Rock; Map Unit From Fig. 1)	Characteristics	Constraints on Timing of Mineralization (cf. Fig. 2)
4. SEDIMENTARY					
a) Cu-Fe sulphides, uranium-sandstone	stratiform occurrences of Cu-sulphides, pyrite, uranium minerals in sandstones	Balfron (M50) (11E11-9); Waugh River north of Highlands	grey, tan wackes, siltstones of Pictou Group (Late Carboniferous; 30)	chalcopyrite, pyrite, malachite, uranium minerals found in fluvial sandstones associated with plant remains (coaly layers)	deposition of Pictou Group in Late Carboniferous time; mineralization thereafter, upper limit not known
b) Pb-Zn sulphides, sandstone	stratiform Pb-Zn sulphide in sandstone	Saltspring Brook (M78); east of Londonderry	tan, grey wackes of Pictou Group (Late Carboniferous; 30)	galena, fine grained sphalerite as thin layers (1 mm to 10 mm thick) parallel to laminations; layers of feldspathic wacke are preferably mineralized; fluvial environment	deposition of Pictou Group in Late Carboniferous time; upper limit not known
5. STRUCTURAL					
a) magnetite-pyrite	stratabound or structurally controlled magnetite-pyrite mineralization	Bass River (M27) (11E05-6); north of Bass River village	hornblende-plagioclase-chlorite-quartz gneiss in the Great Village River Gneiss of the Bass River Complex (Proterozoic; 2)	magnetite, pyrite found in concentrations parallel to the prominent metamorphic foliation; found in a lenticular shaped concentration in gneiss on north side of Londonderry Fault and westward 300 m	may be as old as prominent metamorphic foliation (Proterozoic) or as young as Londonderry Fault (Late Carboniferous)
b) Zn-Pb-Cu sulphides, Ag	structurally controlled mineralization; control by faults, cleavage; possibly stratabound	Bass River of Five Islands	siltstones, calcareous siltstones and wackes of unnamed Silurian-Devonian (11B)	galena, sphalerite, pyrite as fine disseminations parallel to bedding and Acadian Orogeny cleavage; silver associated with galena, not found as a separate phase; geochemical highs of Pb and Zn parallel faults trending east-west and northeasterly suggesting fault control	oldest known fault movements on northerly trending faults are "Middle" Carboniferous; possibly movement during Devonian; Acadian cleavage is Middle Devonian; upper limit is probably Jurassic (last episode of northerly trending faulting)

Table 3. Continued.

ASSOCIATION/ Grouping	Characteristics of Grouping	Principal Example			
		Name (No. on Tables 1,2) (NSDME Assessment, occurrence no); Location	Host Rock(s) (Age of Host Rock; Map Unit From Fig. 1)	Characteristics	Constraints on Timing of Mineralisation (cf. Fig. 2)
PEAT BOG DEPOSIT Fe-Mn oxides	iron and/or manganese oxides in peat bogs	Apple River (21H07-4); northeast of Apple River village	peat bog deposit Recent age	Mn-oxide and Fe-oxide and hydrous oxide	younger than the underlying glacial till (<20 000 BP); Holocene

cut by the north-south faults of post-Early Jurassic age. The age of mineralization may be early Late Carboniferous or post-Early Jurassic. The younger age is preferred because of the barite mineralization common to this grouping and the previous one (1e).

Other groupings from Table 3 in which the age of mineralization is reasonably well fixed are 2a and 2b. Both are related to the basalt extrusion event of Late Traissic-Early Jurassic age. The age of mineralization in Late Carboniferous strata classified in groupings 4a and 4b is only known to be Late Carboniferous or younger. The volcanogenic mineralization in groupings 3a and 3b is Middle Devonian or younger based on the age of the volcanic rocks. If the mineralization is not associated with the eruption of the felsic volcanic rocks then it is younger. The base metal sulphide mineralization of grouping 5b appears to be associated with northerly trending faults. This suggests an age of mineralization of either early Late Carboniferous or post-Early Jurassic time (*cf.* Fig. 2). Groupings 1a and 1d involve mineralization of rocks deformed by the Acadian cleavage and by east-west trending faults. This means the oldest age the mineralization can be is Middle Devonian. Iron and manganese oxide mineralization of grouping 1c is younger than the previous groupings because it cuts the Hercynian-Alleghenian cleavage and is associated with east-west trending faults. No timing for mineralization in grouping 5a can be suggested because few constraints can be found.

CONCLUSIONS

The Cobequid Highlands area is underlain by varied and complex geological units (Fig. 1). As a whole, the rocks of the area have been deformed during at least four orogenies. Faulting and plutonic activity have accompanied the younger two orogenies and probably the older two. Mineralization is primarily confined to the Middle and Late Paleozoic (Middle Devonian and "Middle" Carboniferous) and Middle Mesozoic times. Faulting has influenced the location of many of the occurrences, but the association of mineralization and plutonism is not directly known.

The varied lithotypes and ages of rocks make the Cobequid Highlands an interesting geological entity. The numerous mineral occurrences, varied geological units and the abundance of important deep faults and young (Carboniferous) granites provides an incentive for exploration.

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RB/SR AGE DATA FOR THE CREIGNISH HILLS PLUTON

R. F. Cormier*

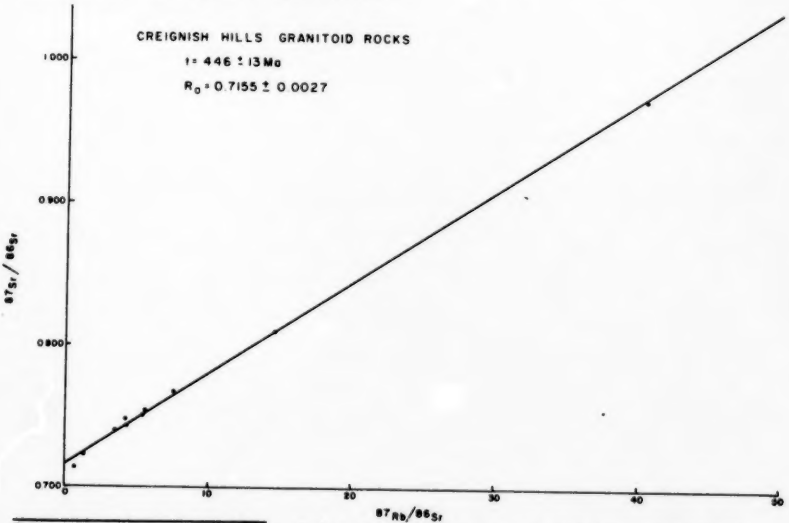
ANALYTICAL DATA

Sample No.	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
F14 1029 WR	297	21.7	40.5	0.9718
F14 1041 WR	249	49.8	14.6	0.8087
F14 1103 WR	199	77.7	7.46	0.7661
F11 1041 WR	154	79.2	5.64	0.7535
F14 1224 WR	174	94.0	5.37	0.7496
F14 1078 WR	163	110	4.30	0.7423
F11 1016 WR	153	105	4.24	0.747"
F14 1134 WR	162	135	3.48	0.7383
F14 1000 WR	122	273	1.30	0.7216
F14 1010 WR	70.6	301	0.678	0.7133

$t = 446 \pm 13$ Ma $R_o = 0.7155 \pm 0.0027$

Errors at 95% confidence level; $^{87}Rb = 1.42 \times 10^{-11}$ yr.$^{-1}$.

Samples submitted by Sandra Barr, Acadia University, Wolfville, Nova Scotia; analyzed by R. F. Cormier, Department of Geology, St. Francis Xavier University, Antigonish, Nova Scotia.



*Geochronology Laboratory, Saint Francis Xavier University, Antigonish, Nova Scotia.

RB/SR AGE DATA FOR THE FOUNTAIN LAKE GROUP VOLCANICS

R. F. CORMIER*

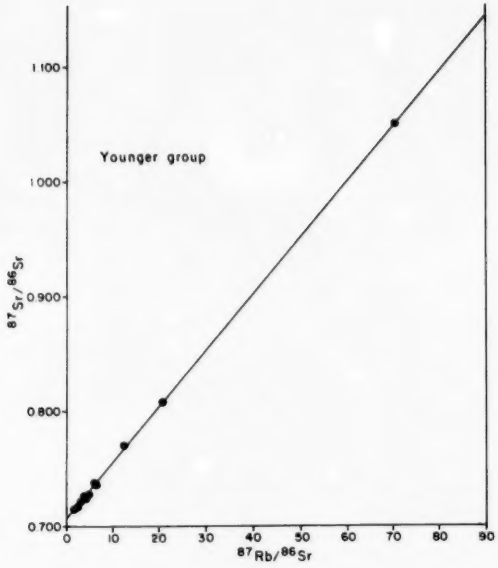
ANALYTICAL DATA

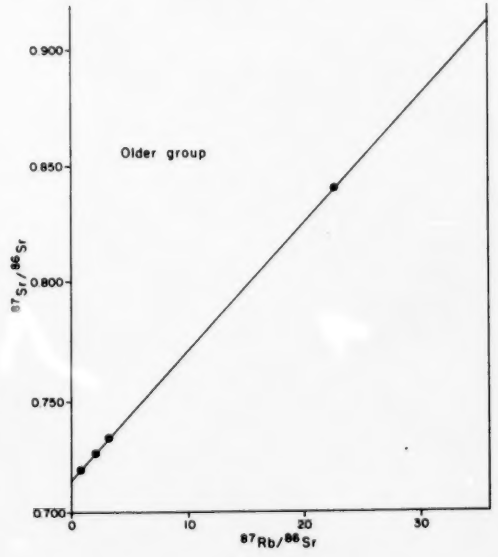
Sample No.	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
Younger group - 341 ± 4 Ma with R_o = 0.7075 ± 0.0012				
E11-4434	650	27.4	70.6	1.0507
E11-4445	174	24.8	20.5	0.8072
E11-4440	205	48.6	12.3	0.7702
H08-4431	150	67.8	6.44	0.7365
H08-4424	141	67.6	6.05	0.7369
H08-4432	98.3	61.0	4.66	0.7283
H08-4426	87.5	60.2	4.21	0.7247
H08-4448	205	157	3.79	0.7279
H09-4410	126	129	2.84	0.7219
E12-4518	135	166	2.36	0.7189
H08-4447	124	259	1.39	0.7165
Older group - 387 ± 2 Ma with R_o = 0.7140 ± 0.0003				
E12-4498	221	28.4	22.8	0.8398
E12-4500	231	207	3.23	0.7320
E11-4544	85.6	117	2.13	0.7254
E12-4499	97.3	359	0.785	0.7184

Note: $^{87}Rb = 1.42 \times 10^{-11} yr.^{-1}$

Errors at 95% confidence level (2 standard deviations)

*Geochronology Laboratory, Saint Francis Xavier University, Antigonish, Nova Scotia.


Younger group
1.100
1.000
0.900
0.800
0.700
$^{87}Sr/^{86}Sr$
0
10
20
30
40
50
60
70
80
90
$^{87}Rb/^{86}Sr$


Older group
0.900
0.850
0.800
0.750
0.700
$^{87}Sr/^{86}Sr$
0
10
20
30
$^{87}Rb/^{86}Sr$

OPEN ASSESSMENT REPORTS FOR 1981

11D/12C 54-H-84(01) (433006)	Uranium	Pogwa Lake, Halifax County	Rept. on Geol., Stream Sed., Soil and Rock Geochem. and Ground Rad. Svys., E and B Explorations Ltd., February 1979
11D/15A 21-H-67(16) (432962)	Gold	Tangier, Halifax County	Geol. Rept., L. Blondeau, February 1979
11D/15B 31-H-29(06) (433253)	Manganese	Lake Charlotte, Halifax County	Rept. on Geol. and Soil Geochem. Svys., St. Joseph Explorations Ltd., October 1979
11D/16C 21-H-23(06) (433263)	Gold	Harrigan Cove, Halifax County	Rept. on Testing of Bulk Samples, J. Dawe, October, 1979
11D/16C 21-H-23(07) (433264)	Gold	Harrigan Cove, Halifax County	Report on Proposed Heap Leaching Research Project, J. Dawe, October 1979.
11E/NW 54-D-45(02) (433077)	Uranium	Tatamagouche, Colchester County	Rept. on Soil and Radon Geochem. Svys. and Diamond Drilling, Lacana Mining Corp., October 1978
11E/01C 54-G-56(01) (433036)	Uranium	Big Liscomb Lake, Guysborough County	Rept. on Geol. Svy., Airborne and Ground Rad. Svys., Esso Resources Can. Ltd., January 1979
11E/01D 21-G-05(11) (433266)	Gold	Cochrane Hill, Guysborough County	Compilation Rept.-Assays, Reserves, Production, Massval Mines Ltd., February 1979
11E/01D 21-G-05(12) (432812)	Gold	Cochrane Hill, Guysborough County	Drill Logs and Sections, Surface Plan, Massval Mines Ltd., June 1979
11E/02A 07-H-85(01) (433254)	Base Metals	Lake Mulgrave, Halifax County	Rept. on Soil and Stream Sed. Geochem. Svys., St. Joseph Explorations Ltd., October 1979
11E/02A 21-H-01(01) (432128)'	Gold	Beaver Dam, Halifax County	Summary Report on Mill Tests, W. M. Goodwin, 1928

11E/02B 21-H-74(01) (433258)	Gold	Wire Lake, Halifax County	Rept. on Soil, Rock and Stream Sed. Geochem. and EM Svys., St. Joseph Explorations Ltd., September 1979
11E/03B 21-D-21(04) (433044)	Gold	Gays River, Colchester County	Rept. on Geol. Svy. and Exploration Proposal, N. Gass, September 1979
11E/03D 06-D-34(14) (433038)	Barite	Middle Stewiacke, Colchester County	Rept. on Geol. and Gravity Svys. and Diamond Drilling, Esso Resources Can. Ltd., January 1979
11E/04B 03-I-55(15) (433089)	Antimony	West Gore, Hants County	Prelim. Rept. on Extraction of Antimony and Gold from Tailings and Surface Ore Dumps, M. E. X. Explorations Ltd., May 1979
11E/04B 54-I-74(01) (433066)	Uranium	Woodville, Hants County	Rept. on Geol. and Ground Rad. Svys., International Mine Services Ltd., December 1977
11E/04C 54-I-51(01) (433067)	Uranium	Walton, Hants County	Rept. on Geol. and Ground Rad. Svys., International Mine Services Ltd., December 1977
11E/04D 54-I-75(01) (433068)	Uranium	Georgefield, Hants County	Rept. on Geol. and Ground Rad. Svys., International Mine Services Ltd., December 1977
11E/05D 07-D-33(05) (432975)	Base Metals	Londonderry, Colchester County	Rept. on Stream Sed., Well Water and Soil Geochem. Svys. and Mag. Svy., Quebec Uranium Mining Corp., May 1979
11E/06A 07-D-41(05) (433217)	Base Metals	Smithfield, Colchester County	Rept. on Geol. and Soil Geochem. Svys. and Diamond Drilling, Esso Resources Can. Ltd., June 1979
11E/06B 06-D-07(01) (433040)	Barite	Brookfield, Colchester County	Rept. on Diamond Drilling, Esso Resources Can. Ltd., March 1979

11E/07A 54-G-60(01) (433261)	Uranium	Trafalgar, Guysborough County	Rept. on Geol., Stream Sed. Geochem., Airborne and Ground Rad. Svys., Canadian Nickel Co. Ltd., November 1979
11E/07B 07-D-18(06) (433160)	Base Metals	Eastville, Colchester County	Rept. on Soil Geochem. Svy., EM and Mag. Svys., St. Joseph Explorations Ltd., January 1979
11E/07B 07-D-18(07) (433161)	Base Metals	Eastville, Colchester County	Rept. on Diamond Drilling and Assays, St. Joseph Explorations Ltd., April 1978
11E/07B 07-D-18(08) (433256)	Base Metals	Eastville, Colchester County	Rept. on Geol. Svy. and Diamond Drilling, St. Joseph Explorations Ltd., October 1979
11E/07C 07-D-66(01) (433041)	Base Metals	Calvary Stream, Colchester County	Rept. on Geol., Soil Geochem. and Heavy Minerals Svys., Esso Resources Can. Ltd., March 1979
11E/08C CL 15(07) (432568)	Base Metals	Blue Mountain, Pictou, Guysborough and Antigonish Counties	Aeromag. Map, Gordon Minerals Ltd., 1953
11E/09A 07-B-23(05) (432972)	Base Metals	Ohio, Antigonish County	Rept. on Soil Geochem. and Mag. Svys. and Diamond Drilling, Cuvier Mines Ltd., January 1979
11E/09A 54-B-36(02) (433243)	Uranium	James River Station, Antigonish County	Rept. on Geol., Stream Sed., Stream, Well and Spring Water Geochem. Svys., Radon and Ground Rad. Svys., Saarberg Interplan Can. Ltd., October 1979
11E/10A 07-M-39(02) (433235)	Base Metals	Kirkmount, Pictou County	Geol. and Soil Geochem. Svy. Maps, St. Joseph Explorations Ltd., February 1979
11E/10A 07-M-39(03) (433259)	Base Metals	Kirkmount, Pictou County	Rept. on Soil Geochem. Svys., St. Joseph Exploration Ltd., September 1979

11E/11A 54-D-67(01) (433183)	Uranium	Earltown, Colchester County	Rept. on Geol. Svy., Soil, Stream Sed., Stream and Well Water Geochem. Svys., Airborne and Ground Rad. Svys., Airborne Mag. Svy., and EM Svy., Wyoming Mineral Corp., June 1979
11E/11B 54-D-16(03) (433420)	Uranium	East New Annan, Colchester County	Rept. on Prospecting, Geol., Soil and Rock Geochem. and VFL Svys., and Overburden Drilling, Gulf Minerals Can. Ltd., December 1979
11E/11C 54-D-45(14) (433114)	Uranium	Tatamagouche, Colchester County	Rept. on Geol. Svy., Diamond Drilling, Gamma Ray and Resistivity Logging, and Core Analyses, Noranda Exploration Co. Ltd., May 1979
11E/11C 54-D-45(15) (433269)	Uranium	Tatamagouche, Colchester County	Rept. on Diamond Drilling, Noranda Exploration Ltd., November 1979
11E/11D 54-D-68(01) (433279)	Uranium	Balfron, Colchester County	Rept. on Geol, Soil, Stream Sed., Rock and Well Water Geochem. Svys., and Ground Rad. Svy., Wyoming Mineral Corp., October 1979
11E/12A 54-E-64(01) (433182)	Uranium	Westchester, Cumberland County	Rept. on Geol. Svy., Soil, Stream Sed. and Stream Water Geochem. Svys., Airborne and Ground Rad. Svys., Airborne Mag. Svy., EM Svy., and Diamond Drilling, Wyoming Mineral Corp. May 1979
11E/12A 54-E-64(02) (433278)	Uranium	Westchester, Cumberland County	Rept. on Geol., Soil, Stream Sed., Well and Stream Water Geochem. Svys., and Ground Rad. Svy., Wyoming Mineral Corp., October 1979
11E/12B 54-D-64(02) (433213)	Uranium	Cobequid Mountains, Colchester County	Rept. on Geol, Soil and Rock Geochem., Ground Rad., EM, Mag. and IP Svys., Gulf Minerals Can. Ltd., August 1979

11E/12B 54-D-64(03) (433215)	Uranium	Cobequid Mountains, Colchester County	Rept. on Geol. and Ground Rad. Svys., Gulf Minerals Can. Ltd., August 1979
11E/12C 40-E-23(01) (432951)	Potash	Oxford, Cumberland County	Rept. on Gravity Svy., Amax Potash Ltd., April 1979
11E/12C 40-E-23(02) (432952)	Potash	Oxford, Cumberland County	Rept. on Resistivity Svys., Amax Potash Ltd., April 1979
11E/12C 40-E-23(03) (434030)	Potash	Oxford, Cumberland County	Rept. on Seismic Svy., Amax Potash Limited, May 1980
11E/12D 54-E-52(03) (433419)	Uranium	Wentworth, Cumberland County	Rept. on Geol., Soil and Rock Geochem., EM and Ground Rad Svys. and Diamond Drilling, Gulf Minerals Can. Ltd., December 1979
11E/14A 54-M-37(04) (433112)	Uranium	River John, Pictou County	Rept. on Diamond Drilling, Resistivity and Gamma Ray Logging, Noranda Exploration Co. Ltd., April 1979
11F/03C 54-G-24(01) (433252)	Uranium	Larry's River, Guysborough County	Rept. on Geol., Soil, Organic Bank, Stream Sed. and Stream Water Geochem. Svys., Ground Rad. and VLF Svys., St. Joseph Explorations Ltd., December 1979
11F/03C 54-G-24(02) (433251)	Uranium	Larry's River, Guysborough County	Rept. on Soil Geochem. Svy., St. Joseph Explorations Ltd., December 1979
11F/04C 21-G-57(01) (433062)	Gold	Country Harbour Mines, Guysborough County	Property Reconnaissance Rept., A. Hudgins, March 1979
11F/04C 54-G-57(01) (433037)	Uranium	Country Harbour Mines, Guysborough County	Rept. on Geol. Svy., Airborne and Ground Rad. Svys., Esso Resources Can. Ltd., January 1979
11F/05B 21-G-07(10) (433060)	Gold	Country Harbour, Guysborough County	Rept. on Diamond Drilling, A. Hudgins, March 1979

11F/05B 21-G-07(11) (433061)	Gold	Country Harbour, Guysborough County	Property Reconnaissance Rept., A. Hudgins, March 1979
11F/06A 07-G-59(01) (433255)	Base Metals	Hazel Hill, Guysborough County	Rept. on Geol., Soil Geochem. and EM Svys., St. Joseph Explorations Ltd., October 1979
11F/10D 07-O-63(01) (433250)	Base Metals	St. Esprit, Richmond County	Rept. on Soil, Stream Sed., Rock and Bog Geochem. Svys., EM and Mag. Svys., Duval International Corp., November 1979
11F/11B 07-G-58(01) (433262)	Base Metals	Goose Harbour Lake, Guysborough County	Rept. on Geol., Soil, Rock and Stream Sed. Geochem. Svys., Teck Exploration Ltd., October 1979
11F/11D 07-O-03(01) (433031)	Base Metals	Black River, Richmond County	Rept. on Geol. and Soil Geochem. Svys., Esso Resources Can. Ltd., December 1978
11F/12B 07-B-37(01) (433032)	Base Metals	Pomquet River, Antigonish County	Rept. on Geol., Soil Geochem. and Heavy Mineral Svys., Esso Resources Can. Ltd., December 1978
11F/12C 07-B-29(02) (433113)	Base Metals	Pomquet, Antigonish County	Rept. on Geol. and Basal Till Geochem. Svys., Noranda Exploration Co. Ltd., March 1979
11F/14C 25-J-21(07) (433143)	Iron	Glencoe, Inverness County	Rept. on Geol. Svy., Trenching and Assays, W. S. Shaw, March 1979
11F/14D 40-J-77(01) (433111)	Potash	Ashfield, Inverness County	Rept. on Gravity Svy., Geophys. Logging and Diamond Drilling, Noranda Exploration Co. Ltd., January 1979
11F/14D 40-J-77(02) (433267)	Potash	Ashfield, Inverness County	Rept. on Gravity, Mag. and Aeromag. Svy. Interps., Noranda Exploration Co. Ltd., June 1978
11F/15A 07-O-62(01) (433162)	Base Metals	Enon, Richmond County	Rept. on Diamond Drilling, St. Joseph Explorations Ltd., June 1979

11F/15A 28-O-09(00) (431560)	Limestone	Irish Cove, Richmond County	Memo on Drilling, 1949
11F/15A 28-O-09(01) (431561)	Limestone	Irish Cove, Richmond County	Misc. Repts. on Diamond Drilling and Assays, 1949 to 1963
11F/15C 07-Q-09(04) (433188)	Base Metals	Jubilee, Victoria County	Drill Logs, Svy. Plans and Geol. Map, Amax Exploration Ltd., July 1979
11F/16B 07-O-25(01) (432969)	Base Metals	Stirling, Richmond County	Rept. on Geol., IP and Mag. Svys. and Diamond Drilling, Cominco Ltd. November 1978
11F/16B 07-O-25(02) (433277)	Base Metals	Stirling, Richmond County	Rept. on Geol., Rock Geochem., Airborne EM and Mag. Svys., Cominco Ltd., November 1979
11F/16B 27-C-07(04) (433265)	Lead	Big Glen, Cape Breton County	Rept. on Geol. Svy. and Diamond Drilling, Pacific Coast Mines Inc., April 1979
11F/16C 07-C-53(03) (433270)	Base Metals	Glen Morrison, Cape Breton County	Rept. on Soil Geochem. Svy., Diamond Drilling, Pit Digging and Trenching, Chevron Standard Ltd., November 1979
11F/16C 07-C-101(02) (433271)	Base Metals	Otter Lake, Cape Breton County	Rept. on Soil and Stream Sed. Geochem. Svys., Chevron Standard Ltd., October 1979
11F/16D 07-C-31(02) (433086)	Base Metals	Deep Cove, Cape Breton County	Summary Rept. on Exploration Programs and Related Costs, Louisbourg Property Holdings Ltd., May 1978
11F/16D 07-C-31(03) (433087)	Base Metals	Deep Cove, Cape Breton County	Rept. on Estimation of Value of Known Mineral Resources, Louisbourg Property Holdings Ltd., March 1978
11K/01D 07-C-99(01) (434009)	Base Metals	Victoria Junction, Cape Breton County	Rept. on Geol., Diamond Drilling, Core Analyses and Gamma Ray Logging, Cape Breton Development Corp., February 1980

11K/03A 54-J-31(03) (433246)	Uranium	Lake Ainslie, Inverness County	Rept. on Geol., Soil, Stream Sed., Stream Water and Radon Geochem. Svys., and Ground Rad. Svy., Saarberg-Interplan Can. Ltd., December 1979
11K/03B 07-J-22(02) (433034)	Base Metals	Glendyer, Inverness County	Rept. on Geol., Soil Geochem. and Heavy Mineral Svys., Esso Resources Can. Ltd., December 1978
11K/03C 07 -42(03) (433268)	Base Metals	Mabou Highlands, Inverness County	Rept. on Geol., Soil and Stream Sed. Geochem. and EM Svys., and Diamond Drilling, Noranda Exploration Co. Ltd., August 1979
11K/03D 18-J-56(02) (434150)	Fluorite	Scotsville, Inverness County	Diamond Drillhole Logs and Sections, Cera, November 1970
11K/06A 54-J-85(02) (433244)	Uranium	Southwest Margaree, Inverness County	Rept. on Diamond Drilling and Gamma Ray Logging, Saarberg-Interplan Can. Ltd., December 1979
11K/06A 54-J-85(03) (433245)	Uranium	Southwest Margaree, Inverness County	Rept. on Geol., Stream Sed., Well Water, Stream Water and Radon Geochem Svys. and Ground Rad. Svy., Saarberg-Interplan Can. Ltd., December 1979
11K/07B 07-J-86(01) (433249)	Base Metals	Ryan Brook, Inverness County	Rept. on Geol., Soil, Stream Sed. and Rock Geochem. Svys., Mag. and EM Svys., Duval International Corp., November 1979
11K/07B 07-Q-24(02) (433257)	Base Metals	Sarach Brook, Victoria County	Rept. on Geol., Soil, Stream Sed., Rock and Heavy Mineral Geochem. Svys., St. Joseph Explorations Ltd., October 1979
11K/10B 07-J-09(48) (432956)	Base Metals	Cheticamp, Inverness County	Rept. on Geol., Stream Sed. and Soil Geochem. Svys., Mag., EM and IP Svys., and Diamond Drilling, Yeoman Syndicate, April 1979

11K/10B 07-J-69(04) (433179)	Base Metals	Fisset Brook, Inverness County	Rept. on Linecutting, Topo., Geol., Soil and Stream Sed. Geochem. Svys., Mag., VLF and IP Svys., and Assays, Utah Mines Ltd., June 1979
11K/10B 07-J-70(03) (433178)	Base Metals	NE Margaree Valley, Inverness County	Rept. on Geol., Mag., VLF, IP and Soil Geochem. Svys., Utah Mines Ltd., January 1979
11K/16B 54-Q-44(01) (433035)	Uranium	Neils Harbour, Victoria County	Rept. on Geol. Svy., Airborne and Ground Rad. Svys., Esso Resources Can. Ltd., January 1979
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20P/13C 54-R-29(01) (432997)	Uranium	Peter Lake, Yarmouth County	Rept. on Geol., Soil and Stream Sed. Geochem. Svys. and Ground Rad. Svy., E and B Explorations Ltd., February 1979
20P/14C 54-P-11(01) (433282)	Uranium	Upper Ohio, Shelburne County	Rept. on Geol., Stream Sed. and Soil Geochem. Svys. and Ground Rad. Svy., E and B Explorations Ltd., January 1979
20P/15B 54-N-29(01) (432994)	Uranium	Path Lake, Queens County	Rept. on Geol., Soil and Stream Sed. Geochem. Svys. and Ground Rad. Svy., E and B Explorations Ltd., January 1979
21A/NW 54-A-25(01) (433281)	Uranium	South Mountain Area, Annapolis, Digby, Kings Counties	Rept. on Geol., Soil Geochem., Biogeochem., Airborne and Ground Rad. Svys., Shell Can. Resources Ltd., December 1979
21A/03C 54-R-32(01) (433002)	Uranium	Whitecap Lake, Yarmouth County	Rept. on Geol., Stream Sed. and Soil Geochem. Svys.,and Ground Rad. Svy., E and B Explorations Ltd., April 1979

21A/04A 54-R-25(04) (433083)	Uranium	East Kemptville, Yarmouth County	Rept. on Geol. and Radon Geochem. Svys. and Diamond Drilling, Lacana Mining Corp., November 1978
21A/04A 54-R-25(05) (433231)	Uranium	East Kemptville, Yarmouth County	Rept. on Geol., Soil, Rock, Till, Stream Sed., Lake Sed., Stream and Lake Water Geochem. Svys., Airborne and Ground Rad. Svys. and Rad. Logging, Shell Can. Resources Ltd., October 1979
21A/04A 54-R-30(01) (432998)	Uranium	Beaver Creek Lake, Yarmouth County	Rept. on Geol., Soil Geochem. and Ground Rad. Svys., E and B Explorations Ltd., February 1979
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21A/09B 51-L-11(02) (433147)	Tin	Henry Lake, Lunenburg County	Rept. on Till Geochem. Svy., Shell Can. Resources Ltd., September 1978
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21A/10B 54-A-22(01) (433003)	Uranium	Cranberry Lake, Annapolis County	Rept. on Geol., Stream Sed. and Soil Geochem. and Ground Rad. Svys., E and B Explorations Ltd., April 1979
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21A/10C 54-A-20(03) (433220)	Uranium	Dalhousie East, Annapolis County	Rept. on Soil Geochem., Radon and Ground Rad. Svys., Esso Resources Can. Ltd., March 1979
21A/10C 54-A-20(04) (433226)	Uranium	Dalhousie East, Annapolis County	Rept. on Geol., Soil Geochem., Radon and Ground Rad. Svys., Esso Resources Can. Ltd., June 1979
21A/10C 54-A-23(01) (433007)	Uranium	Falkland Ridge, Annapolis County	Rept. on Geol., Stream Sed., Soil Geochem. and Ground Rad. Svys., E and B Explorations Ltd., March 1979

21A/10D 54-L-31(01) (433218)	Uranium	Sherbrooke Lake, Lunenburg County	Rept. on Geol., Soil, Lake Sed., Lake Water and Radon Geochem. Svys. and Ground and Airborne Rad. Svys., Esso Resources Can. Ltd., March 1979
21A/11C 54-A-24(01) (433229)	Uranium	Lambs Lake, Annapolis County	Rept. on Geol., Soil and Till Geochem. Svys. and Diamond Drilling, Shell Can. Resources Ltd., February 1979
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21A/15C 54-A-17(01) (433153)	Uranium	Torbrook, Annapolis County	Rept. on Geol., Stream Water, Well Water, Stream Sed., Soil and Rock Geochem. Svys., Mag., VLF and Airborne Rad. Svys., Shell Can. Resources Ltd., February 1979
21A/15C 54-A-17(02) (432836)	Uranium	Torbrook, Annapolis County	Stream and Well Water Sample Location Maps (2), Shell Can. Resources Ltd., February 1979
21A/15C 54-A-17(03) (433228)	Uranium	Torbrook, Annapolis County	Rept. on Geol., Soil and Radon Geochem. Svys., EM, Mag., Airborne and Ground Rad. Svys., Shell Can. Resources Ltd., August 1979
21A/15C 54-K-29(01) (433280)	Uranium	Cloud Lake, Kings County	Rept. on Geol., Soil Geochem., EM, Mag., Track Etch, Airborne and Ground Rad. Svys. and Diamond Drilling, Shell Can. Resources Ltd., December 1979
21A/15D 54-K-25(03) (433225)	Uranium	Gaspereau Lake, Kings County	Rept. on Soil Geochem. and Radon Svys. and Diamond Drilling, Esso Resources Can. Ltd., May 1979

21A/16B 54-I-64(02) (432959)	Uranium	Millet Brook, Hants County	Rept. on Soil Geochem., Ground Rad. and Radon Svys., Aquitaine Co. of Can. Ltd., May 1979
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21H/01D 06-I-23(01) (433094)	Barite	Kempt Shore, Hants County	Rept. on Geol. and Stream Sed. Geochem. Svys. and Diamond Drilling, D. Johnston, December 1978

21H/01D 06-I-23(02) (433093)	Barite	Kempt Shore, Hants County	Rept. on Geol. and Stream Sed. Geochem. Svys. and Diamond Drilling, D. Johnston, December 1978
21H/01D 54-I-05(05) (433241)	Uranium	Cheverie, Hants County	Rept. on Diamond Drilling and Gamma Ray Logging, Saarberg-Interplan Can. Ltd., December 1979
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21H/09D 54-E-41(01) (434057)	Uranium	Springhill, Cumberland County	Rept. on Geol., Soil Geochem. and VLF Svys. and Diamond Drilling, Cominco Ltd., February 1980
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OFR 446 Coal Tonnages Mined and Tons Remaining in Workings Around Stellarton, Westville and Thorburn, by V. Stallard, 1976, 40 pages.

OFR 447 Report on Kemptown Coal Area, Colchester County, Nova Scotia, by T. G. N. Covert, 1975, 7 pages, 1 cross-section, 2 profiles.

OFR 448 Report on DDNSP-45, New Seam-Stellarton Area, Pictou County, Nova Scotia, by E. W. Smith, 1978, 6 pages, drill log, gamma ray log, profile, coal resources map.

OFR 449 Report on DDNSP-46, by E. W. Smith, Nova Scotia Department of Mines, 1978, 12 pages, drill log, gamma ray log, profile, correlations.

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OFR 451 Debert Coal Basin, Colchester County, Nova Scotia, by T. G. N. Covert, 1975, 49 pages, analyses, 4 sections.

OFR 452 The River Hebert Sub-basin - Assessment, by E. W. Smith, 1979, 20 pages, 3 maps.

OFR 455 Geological Map of the Cobequid Highlands, by H. V. Donohoe and P. I. Wallace, 1980, scale 1:50 000, 4 maps plus legend.

OFR 456 Geological Appraisal of Coal Resources in the Rodney Seam of the Springhill Coalfield, by J. H. Calder, 1980, 23 pages, seam profiles, analyses, 6 maps.

OFR 457 Report to the Atomic Energy Control Board on Uranium Exploration in Nova Scotia in 1977, by Gulf Minerals Canada Limited, 1978, 29 pages, drill logs, 12 maps.

OFR 458 Progress Report to the Atomic Energy Control Board on Uranium Exploration in Nova Scotia in 1978, Esso Resources Canada Limited, 1979, 8 pages.

OFR 459 Quarrying and Sizing Limestone for Metallurgical Purposes at Irish Cove and the Use of Sized Limestone in Steelmaking, by J. N. Gillis and L. C. Johnston, 1966, 18 pages.

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OFR 461 Geophysical Series for Antigonish-Pictou Highlands, High Resolution Aeromagnetic Total Field and Vertical Gradient Maps, 28 maps, scale 1:25 000, and 2 summary maps, scale 1:125 000, by Nova Scotia Department of Mines and Energy and Geological Survey of Canada, 1981.

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OFR 463 Preliminary Assessment of the Peatland Resources of Southwestern Nova Scotia, by A. R. Anderson and W. Broughm, 1981, 56 pages, peat isopach, elevation and surface cover maps.

OFR 464 Reclamation of Westville Area Coal Waste Dumps - Feasibility Study, Volume 2 of 2, by Nova Scotia Department of Mines and Energy, 1980, 199 pages, drillhole location map, cross-sections, partition and distribution curves, correspondence, agreements.

OFR 465 Aggregate Resources in Nova Scotia, by J. H. Fowler, 1981, 11 pages.

OFR 466 Report to the Atomic Energy Control Board for the Year 1979, Nova Scotia, by Gulf Minerals Canada Limited, 1971, 31 pages, drillhole logs, analyses.

OFR 467 Bedrock Geology of Kejimkujik National Park, by L. M. Cumming, 1979, 415 pages, geology map.

OFR 468 Stratigraphy and Depositional History of Marine Evaporites in the Lower Carboniferous Windsor Group, Shubenacadie and Musquodoboit Structural Basins, Nova Scotia, Canada, by R. C. Boehner, 1981, 28 pages.

OFR 469 Summary Report to the Atomic Energy Control Board for Saarberg-Interplan Canada Limited, Nova Scotia Uranium Project, Hants and Kings Counties, Nova Scotia, by O. A. Seeber, 1978, 17 pages.

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OFR 471 Preliminary Airborne Gamma Ray Spectrometry Maps and Ground Investigations, Central Nova Scotia, NTS - 11D, 11E and parts of 11F and 21H, by K. L. Ford, J. M. Carson and P. B. Holman, 1981, 3 maps, scale 1:1 000 000, 1 sheet of profiles, chemical analyses, Geological Survey of Canada Open File 789.

OFR 472 Geophysical Series for Chester, Windsor and Wolfville, Airborne Gamma Ray Spectrometry Maps, NTS - 21A/09, 21A/16 and 21H/01, by Geological Survey of Canada, 1981, 21 maps, scale 1:50 000, 180 sheets of profiles. (available only from the Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario, K1A 0E8)

OFR 473 Eastern Shore Project - Preliminary Report, by B. Jones, 1981, 35 pages, photographs.

OFR 474 Liquefaction Studies on Nova Scotia Coals, by J. J. Starzomski, 1980, 20 pages.

OFR 475 Geology of the Eureka Map Area, Pictou County, Nova Scotia, by P. S. Giles, 1981

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OFR 479 Geological Maps of the Wolfville Area, by S. A. Ferguson and G. R. Stevens. 1980, Legend and 5 maps, scale 1 inch to 400 feet.